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EXPERIENCE IN FISHING BOATBUILDING APPLICABLE TO THE IPFC REGION*

Jan-Olof Traung**

ABSTRACT

The application of naval architecture to small fishing boat construction is a recent innovation. The layout of a boat, general arrangement of the wheelhouse and engine, fuel tanks and fish hold, depend on the actual fishing method and suggestions are made regarding trawlers, longliners, purse seiners, and gill-netters. Mechanization of existing fleet has been easy when traditional craft have been large and sturdily built. With small craft such as canoes and rafts, it has been necessary to design new types of craft. Outboard motors seem to be suitable for small craft and have been well accepted in many countries of the Indo-Pacific Region. Selection of engines must be done with care and it is not economical to install too high-powered engines. A propeller efficiency of at least 50% should be aimed at and the optimum pitch-diameter ratio for small fishing craft is about 0.6. Propeller posts should be sharpened to increase efficiency. Propeller r.p.m. should be low which can be obtained by using a high speed engine with reduction gear. Care should be exercised in the installation of engine. Mechanization of handling of fishing gear is as important as motorisation of the craft. For boats of less than 16 m. in length, the hydraulic or mechanical winches and other fish handling gear which can be powered from the main engine or auxiliary engine are comparatively simple and hardly any difficulty should be encountered in establishing local factories in the IPFC Region. On small open boats, ice boxes appear to be an economic method of stowing the catch. With modern improvements, small steel boats have been found to be cheaper than wooden ones in many parts of the world and the same may apply to this Region. There are also new materials of construction such as aluminum and plastics. The advantages of V-bottom and round-bottom, frames, fastenings, caulking, and painting of wooden boats are discussed. When ordering a boat, the following should be considered: fishing conditions, operational information, economic factors, construction considerations. The importance of drawings is stressed and some hints are given as to boat designs. An account of FAO work in the development of beach landing craft is given.

Introduction

Fishing boats represent the largest investment in any fishing industry. Gnanadoss (1960) has stated that it is the most important investment for individual fishermen; Sen (1960) reported upon an investigation in 1953 in Canada which showed that vessels accounted for 68 percent of the total investment of the Canadian fishing industry, as against 45 percent in 1917 and 59 percent in 1935. He also emphasised the dominant position of fishing vessels in the economics of the industry and how important is the need

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for increasing their efficiency in the effort to catch more fish. Such an increase will add to the world's food supplies, increase the prosperity of the world's fishing industries, and raise the living standards of the fishermen.

Fisheries in the IPFC region are slowly passing from the survey stage where Governments try to determine the nature and availability of the resources and the status of the general economic conditions of the industry, to an action stage, where extension services can be envisaged, particularly the development of sound and economic fishing boats.

The IPFC secretariat considers that it would be valuable for fishery administrators to get a general understanding of problems and experience gained in the design and construction of small fishing boats. Accordingly they have invited the writer to produce a "popular" account of fishing boatbuilding. The following paper is written to meet this request; it is therefore an explanation for non-technical readers of current trends in fishing boat design, and is not a technical account for naval architects. The IPFC has also requested FAO to prepare a handbook on fishing boat design; it is suggested that the present paper be regarded as a draft and first short outline of such a handbook, and that after reading the paper specific requirements as to the content of the handbook may be formulated.

Until quite recently, very little had been written about the design and construction of fishing boats. But two FAO World Fishing Boat Congresses, one held in 1953 and the second in 1959, stimulated research into the field of fishing boats. A number of proposals for new designs and a great amount of technical experience were made known to the fishing world as a result of these congresses and the publication of the subsequent Proceedings (Traung, 1955, 1960). During the last eight years, many more technical papers on the subject have been published, and the world fisheries press has shown greater interest in fishing boats. While this interest is welcome, we note that on the one hand much of the material is highly technical and only intelligible to trained technicians, and on the other, very exaggerated and not very precise statements have been made in the popular fisheries press. Speed particulars are especially highly inflated, and when reading descriptions of fishing boats one should be rather careful about claims for performance.

Any boat, like any house, may be designed by any intelligent person, irrespective of whether or not he has a particular knowledge of the profession, but in order to design really efficient boats, some knowledge of naval architecture is necessary; and naval architecture is closely linked with mechanical engineering. At the moment, it is unfortunate that in most cases departments of naval architecture teach very little about wood and small craft design. What is needed is a course whereby people might specialize in a few subjects, concentrating on fishing boat designing, as is possible for people interested in yacht designing.

An interesting experiment along these lines was made by the Government of India which organised three courses in fishing boat design at the Central Government Fisheries Technological Station in Cochin from 1957 to 1959. Fishery officers with a good general education, but not necessarily engineering specialists, were instructed in the rudiments of naval architecture. After six months of spe-

cialized training, these officers learnt how to design undecked small fishing craft, provided of course they showed interest and had had previous experience in boat-building. The lecture notes of these courses (Gurtner, 1960b) are at present being considered for the basis of a text on fishing boat design.

We all know that Archimedes laid the foundations of the science of hydrostatistics over 2,000 years ago, but it was Steven (1548-1620), a contemporary of Galileo, who rediscovered a large part of Archimedes work and presented it to the scientific world of Europe. In 1746 Pierre Bouguer published his great *Traité de Navire* and in 1775 Chapman published his *Handbook in Naval Architecture*, the first book showing how to calculate the waterline of a ship and estimate its resistance. In the nineteenth century, Froude made model experiments a reality, and from about 1900 on, large steel ships were being built to plans developed on the basis of naval architecture, i.e. to scientific principles applied to the problems of shipbuilding. This science is still developing, and comparatively little is still known about how to predict sea behaviour, minimum stability and strength in a seaway.

The application of modern naval architecture to the design of fishing boats has naturally lagged behind its application to large ships, and it was only in the wake of World War I, which prevented research on merchant ships, that Schaffran in Germany made the first model tests of trawlers. Between the wars, research was undertaken sporadically in Germany and in the United Kingdom. During World War II, different countries engaged in research on fishing vessels and after the war, owners of large fishing vessels started to build boats designed from these scientific findings.

Fishing methods and layout of the boat

Fishing methods determine the general layout of a fishing boat and what is perhaps good in one size may not be good in another. In a still large boat the basic arrangement for the small size might again be the most practical. The main problem is whether wheelhouse and engine should be forward or aft. Very few fishing boats have these important parts midships. There was much discussion about stern versus side trawling at the last FAO Fishing Boat Congress, and it would seem sure that stern trawlers longer than, say, 54.8 m., were equally good, if not better than sidetrawlers. It was suggested that efficient sterntrawlers could be made in smaller sizes, and Gurtner gave an example of the 9.75 m. shrimp trawler developed for India. Alvorsen and Schmidt gave examples of sterntrawlers of 24.38 m. and 30.48 m. with an assymetrical deck arrangement so as to get the longest distance between the trawl winch and the fishing ramp. Venus and Corlett described the 30.48 m. *Universal Star*, in which a gantry was introduced to lift both trawl boards and cod-end and so avoid the necessity of having a long distance between the winch and the stern. In this connection we should not forget that stern trawling has been successfully carried out in the Mediterranean, on the Pacific Coast and the southern coast of North America for long periods; however, these operations are always stated to have been possible due to the comparatively easy weather conditions. During such stern trawling, the trawlnet was handled by along boom on the main mast and it was even said that during heavy weather a temporary side trawling arrangement had to be made. Sterntrawling over a ramp was first introduced from the converted British Navy

vessel *Fairfree*, and then commercially by the British factory ship *Fairtry*. These vessels then inspired the Russians to build a fleet of sterntrawlers in Germany. Then the Germans applied the stern ramp technique to a number of smaller freshfish trawlers, and now sizes as small as 54.8 m. are being fitted out.

Purse seining is a very important fishing method in many countries and here again some boats handle the seine from the stern; others handle it from the side, and in others again the seine is handled by special seine dories and the fishing boat only acts as a towing vessel for the net dories, a carrier receiving the catch. Lately a powered block of large dimensions, and light in weight because it is made of aluminium, has been introduced into purse seiners on both coasts of America and in some other countries. This reduces the necessary man-power considerably and is well worth considering where purse seining is a profitable fishing method. A paper on purse seining (Schmidt, 1960), unfortunately not delivered in time to the last Fishing Boat Congress, is now included in the Proceedings of the Congress.

Another important fishing method is longlining; the Japanese oceanic tuna longlining with large vessels was particularly well described at the Fishing Boat Congress (Kanasashi, Doke and Chigusa, 1960, and Takagi, 1960). Longlining can also be carried out by small craft and has been successful in places like India. Sometimes the longline winch is placed in the bow, but the most correct position is almost midships, where the movement of the ship is as slight as possible. It is important for the captain to keep the longline winch and the fish hauling operations under close observation all the time, and therefore longline boats should preferably be arranged with the wheelhouse aft.

The same argument applies to gillnet and driftnet fishing boats; therefore, a difficult problem is created if we wish to develop a combination fishing vessel for use as a part-time purse seiner and partime longliner and driftnetter. The best solution would seem to be in some kind of assymetrical deck arrangement so that purse seining and possibly sterntrawling can be carried out over the aft deck, and longlining midships, with the captain in the wheelhouse forward, whence he has a good lookout both forward and aft. Such an arrangement does create difficulties in balancing the boat thwartships and also with regard to wind pressure on the superstructures; on the other hand, symmetrical arrangement of boats is really a leftover from the days of the sailing vessels, when it was necessary to have both sides the same during tacking.

To the problem of general arrangement and whether the engine and wheelhouse should be forward or aft must be added that of loading of the fishing boat. A fishing boat goes out with full tanks and ice and returns home with empty tanks and a full fishhold. It is important that both hold and tanks are placed as much midships as possible, so that varying loads in them will not create excessive trim by the bow and the stern.

For tropical conditions it is important to arrange as much ventilation in the crew space as possible, so that the crew have good conditions and can work efficiently. Therefore, crew accommodation above deck is highly recommended. Unfortunately too much superstructure limits the useful deck area, so that compromises must often be made.

Mechanization

Mechanization means shortening the time necessary for travelling to and from the fishing grounds, lengthening the time

spent on the fishing grounds, and saving the physical effort of the fisherman to reach the area. It also means that a shorter time is needed for transporting the catch back to shore so that fishing can be carried out for a longer period without jeopardising the quality of the catch. It has been asserted that the catch can be increased four times in this way (Setna, 1955); it remains to be proved in each individual case whether the income of the fisherman would also increase once the actual expenses of mechanization were paid for.

FAO has participated closely in mechanization schemes in a number of countries and has also studied mechanization schemes in other countries. Specific boat development projects under the expanded technical assistance programme have been undertaken in India, Ceylon, Pakistan, Turkey and Tunisia by members of the Fishing Boat Section who keep in close contact with developments in fishing boat construction in most of the FAO member nations, both by travel, meetings and correspondence.

The decision before the expert arrives in a country in an advisory capacity is always whether it is easier to improve existing boats or to introduce completely new types. The improvement of existing boats has been proposed in Tunisia, Turkey, Pakistan and, to some extent, in India. In Turkey and Pakistan the modest recommendations proposed by FAO were not strictly followed, and the industry really went beyond its limits when it ordered stronger engines than suggested, and also built larger boats. In the places in India where FAO naval architects have been working, it seems as if the proposals for the introduction of completely new types have been more frequently accepted than proposals for modifying existing ones. It is difficult to understand why it should be easier to introduce completely new types than to modify old ones. The psychological explanation might be that a builder who is requested to modify his own "design" considers this as criticism, whereas he feels completely confident if requested to build something new. The fishermen have a more realistic approach to the problem: they look at the cost of investment and possible profits, and are willing to accept new boats immediately once they have been convinced that the suggested boats represent an advantage to them.

A number of the wide variety of fishing boats in use in the IPFC region could no doubt be mechanized in one way or another, even those types which at first sight appear difficult to change over because of weak construction, thinness of hulls, etc. We have a precedent in Ceylon, where catamarans have been mechanized despite the fact that it originally seemed a rather doubtful proposition. The present practice in Ceylon seems to be that orus can be mechanized by outboard motors with extended shafts, so as to bring the propeller deep in the water and keep the vulnerable part of the engine sufficiently high above the water, and de Zylva (1958) has shown how an oru was mechanized by an inboard engine; he has also shown how the raft-type catamarans were mechanized with outboard motors on a pedestal, a practice that has shown promising results in calm weather. In Thailand, river craft are being successfully mechanized by impeller-type outboard units, consisting of American gasoline engines with locally-made propeller shafts. The mechanization of existing fleets is always easier to carry out where boats are large and sturdily built, and this is naturally one

of the reasons why mechanization has been comparatively successful in Hong Kong, Bombay and West Pakistan.

When considering the mechanization of existing craft, one is inclined to consider only permanently installed inboard engines and favour oil engines rather than gasoline ones, as normally heavier taxes are levied on gasoline than on diesel oil. Simpler gasoline engines working on the ignition principle are thus ruled out, not so much because of their higher fire hazards as to the fact that taxes are often levied on the gasoline to maintain roads but not on diesel oil. For areas with canoes, rafts and other craft, outboard mechanization must be considered and if not practicable, then the immediate introduction of new craft installed with inboard engines.

The outboard motor v.s. the inboard

Outboard mechanization has proved to be most successful in the fishing fleets of countries such as the United States, Norway, the Island of Trinidad, and in Senegal, to take but a few examples. In some countries it is still in the transitory stage; however, in the United States it is worth noting that the outboard mechanized fishing boat earns a comparatively good standard of living (Beach, 1960) for the fisherman.

Except in Malaya and Ceylon, the outboard motor is not well accepted in the Indo-Pacific fisheries region; this appears to be contributable to the incorrect introduction of the motors to the area, rather than to different operating conditions from those obtaining in other regions where the same outboard motors have worked successfully.

Outboard motors have many advantages over inboard motors. One is that they are easy to instal on almost any craft. No hole has to be bored for the propeller shaft tube; no rudder has to be arranged in the propeller stream; no casing has to be made for the engine; no fuel tanks, fuel or cooling water pipes have to be installed. Another advantage, which is not always understood, is that because an outboard motor also works as a rudder, the cost of an extra rudder is saved and steering of the outboard motor is much more efficient than with a normal rudder. It was found that in many canoes working in high waves, outboard motors gave sufficient manoeuverability, whereas the conventional installation of inboard engine did not. An ignition engine consumes roughly 50 percent more fuel than a diesel. This fuel is also more expensive per unit, if taxes are disregarded. The motor itself though is much cheaper to purchase; it must often be run for several thousand hours before the heavier fuel cost offsets the smaller investment: Furthermore, ignition engines are built to a simpler design than diesels and are easier to repair, as there is much wider experience in maintaining and repairing automobile and scooter engines. They also take up less space and, if properly installed, the fire hazard could be almost eliminated. Tax-free fuel could be distributed to fishing fleets; the problem of black marketing in such fuel might be overcome, at least for two-stroke outboards, gasoline was sold already mixed with lubricating oil (Traung, 1959; 1960b). The outboard motor has the advantage over inboard motors that, for fishermen with small craft kept on the beach, they can simply carry the motor home with them, or leave it in a central maintenance shop where it can be kept safe and maintained easier than if permanently installed in the boat.

As with every motor, it is important that gasoline engines and especially out-

board motors be regularly maintained; in particular outboard motors made of light alloys corrode easily and must be flushed when used in salt water. In Jamaica, Senegal, and Malaya, fishermen who have learnt to care in this manner for their engines have found annual maintenance expenses have been reduced.

For larger craft, inboard engines are naturally essential—even if units up to several hundred horse power have been purchased as outboard motors is some countries. Inboard gasoline engines are used in the United States up to some 100 h.p., but it seems as if the European practice of operating diesel engines for over 50 h.p. might be more successful in the IPFC region.

Engine selection

When selecting an engine, it must be remembered that the speed power curve for all fishing vessels is very steep because fishing boats are all of the displacement type (Fig. 1). It is comparatively easy to get a reasonable speed with all types of hulls, but after a certain limit, the power demand increases tremendously and all power produced by the engine is simply used to create large waves along the hull, which might give the impression of high speed but which actually only results in an unnecessary use of fuel and thus also requires an unnecessarily high investment in the power plant.

The cost of engines is roughly proportional to the cubic capacity of the cylinders and not to the advertised horse power particulars. Horse power is in principle proportional to the r.p.m. Therefore a 10 h.p. engine running at 1,000 r.p.m. is twice as expensive and also twice as strong as a 10 h.p. engine running at 2,000 r.p.m. On the other hand, if the propeller shaft of a 2,000 r.p.m. engine could be geared down to 1,000 r.p.m. by a suitable reduction gear, and if one disregards the five to ten percent losses in the reduction gear itself, the cheaper 1,000 r.p.m. engine can be made to carry out the same work as the more expensive and heavier 1,000 r.p.m. engine.

One reason why engines with too high propeller r.p.m. are often selected is simply that there is not enough space for a large-diameter propeller on existing small fishing craft. Consideration might be given to rebuilding the aft body of such craft to permit a larger propeller to be fitted, or to place the propeller in some unconventional position, such as on the side of the stern rather than behind it, as is normally done on new constructions.

The fisherman naturally wants to move at as high a speed as possible. He also wants to have a "safety" margin. The engine salesman usually agrees with him, because he wants to sell as many horse power as possible. If, as a result, the fisherman purchases too strong an engine for his craft, he is faced with too high an investment and too heavy a fuel consumption; he also finds that the engine takes too much space and that if he throttles down his engine he makes almost the same speed with half the output, his engine working with incomplete combustion, which results in accelerated carbonizing and other troubles.

Propellers

The propeller's job is to transmit the power of the engine into pushing the boat. Therefore, one of the most important considerations when mechanising boats is that the propeller achieves its highest possible efficiency. Given ideal conditions, this efficiency is placed at about 80 percent, and is reached by large

Atlantic liners and, surprisingly enough, by small, fast pleasure craft. For fishing vessels a propeller efficiency of some 50 percent must be considered good, but unfortunately the majority of fishing boat propellers probably only work with a propeller efficiency of, say, 30 percent. A propeller efficiency of 30 percent will transform the power of a 10 h.p. engine into 3 effective h.p., whereas with a 50 percent efficient propeller, only a 6 h.p. engine would be required. The 20 percent difference in efficiency thus means more than 50 percent more fuel consumption, and an engine which is more than 50 percent stronger and perhaps some 30 to 40 percent more expensive.

The propeller must get sufficient water to work at the desired efficiency. The majority of fishing vessels have square propeller posts which decrease the efficiency of propellers by as much as ten to fifteen percent. Great improvements could be effected if these propeller posts were sharpened, or if wedge-shaped pieces were fitted behind them, to prevent eddies.

If an engine with a sufficiently low propeller r.p.m. has been selected, the most efficient diameter and pitch of the propeller for the boat in question should be chosen. Some engine manufacturers give particulars of "standard" propellers, but these should only be taken as examples of propellers which might work efficiently for one specific type of boat. The relation between diameter and pitch of propellers depends to some extent on the speed of advance at which the propeller works. This speed of advance is the speed of the boat minus the speed of the wake, and as small commercial fishing boats are normally heavier and fuller than pleasure boats, for which these propeller details are mostly given, they make a lower speed and have a higher wake; thus, the propeller works at a much lower speed of advance than that for which the "standard" propellers were selected. To transmit its output most efficiently, such a heavier loaded propeller should normally have a smaller pitch and a larger diameter.

The optimum pitch-diameter ratio for small fishing boats is almost always about 0.6, but it is frequently observed how propeller makers have listed standard propellers with a pitch-diameter ratio of about 1. If the 0.6 pitch-diameter ratio has an efficiency of 55 percent the 1.0 propeller ratio might have an efficiency of only 47 percent; that means a difference of about 15 percent in output and fuel consumption.

Most engine manufacturers have propeller diagrams; with these they can very easily check that a certain propeller is working at the highest possible efficiency and they can also estimate the optimum pitch-diameter ratio. However, before determining the most efficient ratio, the manufacturer must know the type of boat to be fitted and must have exact particulars of the speed which a similar boat can make with the horse power in question. Should the fisherman or boatbuilder, when ordering a propeller, not state the speed correctly, the incorrect pitch-diameter ratio will be established and the best possible propeller performance will not be obtained.

To sum up, when selecting an engine do not choose too high a horse power and see to it that the propeller r.p.m. is sufficiently low to give the highest possible propeller efficiency. Such a low r.p.m. can be achieved by choosing heavy duty engines or high-speed engines with a suitable reduction gear.

Installation

The installation of an engine in an existing boat requires careful consideration. The balance of the craft should not be affected by the installation. A position for the engine should be chosen that does not interfere with fishing operations or storage, and where inspection and engine control can be easily carried out. Small engines must be placed so that hand-starting is easy. If the engine is air-cooled there must be a good supply of fresh air, and hot air should not enter the fishhold.

Marine engines can normally be installed with a much larger inclination than is generally believed, i.e., they can be placed higher up and further aft in boats. The propeller, working somewhat downwards, does not lose in performance but it is important not to increase the inclination recommended by makers, because otherwise there could be trouble with cooling water and lubricating oil circulation. All engines should be fitted with as long seatings as possible. If the engine is a heavy one with few cylinders and therefore likely to vibrate, the foundations should be appropriately solid; new frames might even have to be fitted to support such an engine.

A simple way of ascertaining the best place is first to make a simple full scale pattern. With the help of some plywood or press wood both a longitudinal section and some transversal sections of the engine can be drawn up and fitted together with battens; the "pattern" can then be moved about in the hull to see where it fits best.

Winches

The mechanization of the handling of fishing gear is as important as the motorization of fishing boats. A number of winches and line haulers have been developed in many countries. Trawl winches require extremely heavy power, and careful consideration must be given as to whether this power should be derived from the main engine itself or from auxiliary machinery. Other equipment, such as line haulers, drift-net gurdies and power blocks for purse seining, have comparatively modest power demands which can be met easily. Line haulers are normally driven by the front end of the main engine through a system of belts, shafts, universal joints, etc., but hydraulic line haulers are also on the market; in these power is derived from circulating oil or water. Some line haulers just assist in drawing in the line; others also help in coiling it.

Most fishing winches for boats of less than, say, 24.38 m. are very much simpler in design and construction than marine engines and therefore hardly any difficulty at all should be encountered in establishing local factories for fishing winches in the IPFC region.

Fishholds

Demands for high speed are sometimes justified by the argument that boats must return to port at high speed to avoid fish spoilage; the fish then is simply placed in the bottom of the boat without any cooling and perhaps even without any protection against sun. However, the first requirement in the care of the catch is to keep the surface of the fish moist and to protect it against the sun; the second is to have some kind of cooling. Ice is by far the most important cooling medium; it is not always recognized that it accumulates a large amount of latent heat; if one places 1 kg. of ice at 0°C in 1 kg. of water at 80°C the result will be 2 kg. water at 0°C. Thus the kg. of melting ice brought down the water temperature from 80°C to

0°C. Similarly 1 kg. of ice could do very much to reduce the temperature of fish which might be some 26.7°-32.2°C. when taken out of the water.

Furthermore, the fish-spoiling bacteria in tropical and warm waters are of the *mesophilic* type, which are only active at temperatures above about 15°C so that normal chilling temperatures of 0°-4.4°C would be sufficiently below the critical temperatures to hamper their activity. This differs very much from conditions in cool waters where *psychrophilic* bacteria play the main part. They can be active in temperatures as low as −2.2° to −1.7°C and chilling by ice is not at all as efficient as in warm waters. Small, open fishing boats could have, in warm-water regions, a simple arrangement of small ice boxes. FAO has often recommended that such ice boxes be constructed and put into open boats.

The Fishing Boat Congress paid great attention to the keeping of fish in larger craft, and MacCallum (1960) presented a detailed account on the building of fishholds. He outlined the relationship between economic thickness of insulation and the amount of ice carried, the practical arrangement of stanchions and shelves in fishholds and pointed to the importance of protecting the insulation against inflow of humidity. His information may serve naval architects and boatbuilders as a very useful guide for the construction of efficient fishholds. The freezing of fish at sea was also discussed in detail at the Congress, but unfortunately little material was presented on the new technique of keeping fish in chilled sea water. Chilled sea water should have the same advantages as ice cooling in tropical waters. It also has the further advantage of simplifying the handling of the catch.

Construction materials

Small fishing boats are normally built of wood, even though some countries, such as the Netherlands and Norway, build 12.19 m. and even 9.1 m. boats of steel; there is much discussion as to the relative merits of these two materials, and it looks as if the matter will continue to be debated for a long time to come (Traung, 1955. p. 260). Generally, large steel boats are lighter than wooden ones, but small steel constructions have proved to be heavier. A small steel vessel can be built as lightly as a wooden vessel, but even though the steel itself is undoubtedly stronger than wood, it has sometimes to be made thicker to prevent buckling and to make allowances for corrosion. The fact that steel in itself has great strength seems to give the fisherman a false sense of security in that he thinks he can force a steel boat against heavier seas than he would attempt with a wooden vessel. For small boats steel has the disadvantage that it is not as easy to shape as wood, so that clumsier shapes result; however, with improved welding and mass production techniques and perhaps low capacity with boiler-makers, etc., the construction of small steel boats has cost less than wooden ones in many countries. This might also apply to the IPFC region.

Wood and steel will always be in competition and the best argument in favour of one material over the other will always be the price.

Efforts have been made over the past twenty years to introduce aluminium into the hulls of fishing vessels; in the meantime, practical methods have been devised of welding aluminium, and because this material is comparatively easy to cut with woodworking machinery, band saws, etc., it may well become an important material in fishing boat construction.

Plastic has recently become a very popular material for pleasure boat construction (de Laszlo,1960). Recent calculations show that on a strictly comparative basis, plastic hulls are still more expensive than wooden ones, but the hull is only one part of the cost of the complete fishing boat. Plastic construction in tropical countries has the disadvantage that the resin has to be kept refrigerated in tropical countries before use, but this might also be a problem which time will solve.

Main parts of a wooden boat

The structure of wooden boats consists of a *backbone*, made up of stem; keel and stern post, a *shell*, consisting of the planking and the deck, and *ribs*, such as frames and deck beams. The backbone is to give longitudinal strength and to connect the two halves of the shell and also to protect the vessel against damage during beaching. Connection between the planking and the deck is made up of beam shelves, clamps, and in order to add longitudinal strength, parts of the planking such as garboards, bilge planking and sheer strakes are sometimes made heavier. Further strengthening is also sometimes achieved inside by keelsons and bilge stringers. In large wooden craft additional strength is provided by stanchions between deck beams and the lower parts of the frames, and diagonal steel bands are even placed inside the planking to prevent longitudinal bending of the hull.

The halves of the frames cut off by the inner part of the keel must be connected by floor timbers. Between deck beams and frames it is sometimes necessary to have knees, to prevent torsion of the hull. The different parts of the hull are given the common name of "scantlings".

V-bottom v. round bottom

Much was said during the first and second FAO Fishing Boat Congresses about the advantage and disadvantage of having a hull round-bottomed or V-bottomed, or with a double chine. It is probably undeniable that a well-designed V-bottom boat is a better boat than a badly-designed round bottom boat, both in so far as seakindliness and speed are concerned. Equally well-designed V-multichine or round bottom boats are practically equally seakindly, but research seems to indicate that the round bottom and multi-chine boats are somewhat less resistant than V-bottom boats.

Single-chined V-bottom boats can be made to have the same rolling characteristics as round-bottom boats, but due to the design of the flat surface in the foreship, pitching would probably be somewhat more uncomfortable.

From the design point of view, it is no doubt simpler to make a drawing of a V-bottom or multi-chine boat because of the straight lines, and similarly when it comes to mould-loft working and marking up of material, there is a simplification. However, there are quite divergent opinions about the simplicity of building V-bottom wooden boats. Some builders will quote less for a V-bottom, and others less for a round-bottomed boat. The frame of a V-bottom boat consists of two pieces on each side, which have to be connected by a bracket and the frame of a round bottom boat can simply be made in one length. Frame construction therefore seems to be more complicated. On the other hand, planking is somewhat easier in V-bottom boats, despite the fact that the seams of the planks in a V-bottom must also be bevelled. V-bottom and multi-chine construction gain in importance when it comes to using sheet material

such as plywood or metal in planking. Thus one can also introduce the further simplification of longitudinal frames.

However, contrary to general belief, the time used in framing and planking larger fishing vessels is comparatively short when compared with the total time required for making the complete hull, with deck, engine installation, accommodation, etc., and even a comparatively great gain in time in the V-bottom construction of the shell does not turn out to be very great in the final cost. This remark is only valid for experienced boatbuilders, as V-bottom construction seems to offer less difficulty to the inexperienced, and it might be the best way of beginning boatbuilding.

Frames

Frames in wooden vessels can be made by sawn pieces bolted together to build up the structure, by bent frames in one piece, or by bent angular iron. Practices vary over the world; bent iron frames are normally only used by boatyards used to building pleasure yachts in this composite way.

Sawn frames are made either singly with cleats, to connect the pieces, or as double frames where the two halves of the frame form cleats as well. In Denmark double frames are used where the two halves are placed at a certain distance from each other. This method is said to permit a better air circulation around the frames, and to prevent rotting. The Danish practice seems to be at least equally as good as the practice of having the two halves close together, and this raises the question of whether frames should be considered as a beam or just a way of keeping the planking together. A double sawn frame has naturally a much larger moment of inertia than the much smaller bent frame or iron angle frame, and the fact that the two latter types of construction are proven, seems to confirm that the mission of the frame is not so much to give the boat its shape as to keep the pieces of the planking together – the planking then acting as a shell in arc form, which keeps the shape.

There are naturally varieties of these principal types of frame construction. Sometimes sawn frames are used at long distances apart with bent frames in between, and in other cases one uses angle iron frames, with bent frames in between. When deciding upon the type of framing, the decision has to be based not only on whether the sawn frames or the thinner bent and angle iron frames are cheaper, but also upon the space required. A sawn frame is much deeper and does in fact take away quite a lot of inside space from the hull.

Bent frame and angle iron construction requires much less space, which means that the engine can be installed further aft or further forward, that there will be more space for bunks in crew accommodation and that the volume of the hold will be considerably greater.

One argument in favour of bent frames is that in selecting the material one has to be very careful to get straight grain material, and in the bending process one tests whether the frame is good or not. If it breaks, it should naturally immediately be replaced by a good piece, and this practice makes it necessary only to use the best possible material. With sawn frames however, the lowest quality material can be used, and there are frequent examples of how knots, sapwood and even bark have been built into the boats. This naturally shortens the boat's life span.

Builders who have got used to bent frame construction consider it to be cheaper in material cost, due to less quantities of material being needed, even if that material has a higher unit cost, and they also soon find that less labour is involved in boatbuilding with bent frames.

Wood can be bent after having been heated on an open fire, but this dries out the wood, burns the surface; it is a practice which should be discarded. In India the wood is soaked with some vegetable oil during this process but does not suffer too much however. In bending wood, either for frames or planking, the steaming method is definitely the best process, and is not as difficult as is normally believed. Most small boatyards use a kind of heated water vessel from which the vapour is let off into an insulated drum in which the planks and the frames are placed. About one hour's steaming is sufficient for 25 mm. thickness of material, and, surprisingly enough, the wood does not seem to absorb much moisture during such steaming. Investment in a small steambending plant should not amount to much more than U.S. $100. It is important to use steam, and not boiling water, and not to oversteam, because it has been found that wood can be "cooked" in water.

Angle iron frames do not offer much advantage over bent frames. They have to be made on special frame planes operated by a blacksmith or a builder used to steel construction. They must be hot-dip galvanized after manufacture; the large frames require quite large plants for this galvanizing.

Fastenings

Simpson (1960) gives quite a number of useful recommendations with regard to fastenings of larger fishing vessels. He based his findings on carefully conducted experiments, and stresses the importance of round fastenings over square ones; he also shows that a number of smaller fastenings are stronger and cheaper than a few heavy ones, and points to the importance of pre-boring somewhat smaller than the fastening; he shows that there is a direct relationship between the diameter of the pre-bored hole and the diameter of the fastening. His statement that a round fastening is stronger than a square one has met with considerable opposition, due to the fact that many fastenings are made square and have been since the days when they were handmade. Machine manufacture makes square fastenings more expensive, but handmade fastenings are cheaper in square sections. Also if one considers a square fastening in a hole, one must agree that the pressure of that fastening towards the wood is much more unevenly distributed than that of a round fastening. Fastenings under review are such as spikes and drift bolts, which depend for their holding power on friction.

Caulking

It is a general belief that there should be caulking in between the individual planks in a wooden fishing boat, yet almost all pleasure yachts are built without caulking. A caulked boat has to be recaulked at regular intervals, and it is then often observed how the hull is stiffening up and getting sturdier, due to the caulking. If the planking can be considered as a complete panel, and if the caulking is gone and each plank is working individually, recaulking naturally means bringing back the individual pieces of the planking into a complete panel. However, if the individual pieces are made to fit from the beginning and are made of seasoned timber so that they

do not open up during construction, they will swell somewhat when the boat is in the water and immediately form such a panel. This is what happens during yacht construction, where the wood is often dried down to 20 percent humidity; this is below atmospheric humidity. In good yacht yards, the hull is sometimes so dry that one can place a cigarette in the bottom of the hull before launching and then, after launching, go down and take it up and light it.

Frequently one observes fishing boats under construction where the seams are so well made that caulking seems to be unnecessary. If such is the case the seams should not be made wedge-shaped but should fit tightly both inside and out. This not only saves the cost of caulking during construction, but also the cost of recaulking later on. Ringhaver (1960) described how shrimp trawlers up to 21.33 m. were built in Florida without caulking, and the writer inspected these vessels both after the original launching and after five years in use. For small boatyards, it would be well worth considering the method of making planking to fit, not only to save the cost of caulking but as a general economy in time and material.

In this connection, Hanson (1960) has stressed the danger of overcaulking boats and of spoiling the connection of the planks to the frames by using too much caulking applied with too strong and uneven pressure.

Painting

Boats are painted to look attractive and to be hygienic, but also to preserve the wood and to prevent attack by marine borers and the growth of algae and barnacles. Many boats are too well painted, and it might be worth mentioning the experience of the Norwegian Polar ship *Fram* which sailed around Eurasia in 1893/96. This boat was designed by one of the leading naval architects of that time—Colin Archer—and was built of the most carefully selected materials by the best Norwegian boatbuilders. It was decided to impregnate the vessel as well as possible, and everything was painted inside and out with tar. It was found after a few years that serious dry rot had set in, and as it had been decided to use the ship as a national monument, it was important to find out what could be done to save it from further disintegration. It was decided to remove the paint from the inside surfaces so as to permit the wood to breathe and by this simple measure, further decay was arrested. The ship may still be seen in Oslo.

This brings up the point of painting and the importance of letting the wooden members have access to fresh air to avoid dry rot. Dry rot normally occurs at the inside corner of the planking and the decking in enclosed cupboards and everywhere where air circulation is impossible. It is perhaps typical that the tops of frames and the top planks of the planking and not those in contact with water are normally the first ones to be replaced in decked vessels.

In this connection we might also consider the use of insulation. If a fishhold is insulated in a wooden fishing boat and this insulation is made watertight inside to prevent melting ice water from seeping into the insulation and decreasing its properties, one will get the same effect as when a glass with a cool drink condenses on the outside. The moisture of the air will be attracted to the cold surface and this moisture will travel from the outside air through the planking and condense in the insulation, resulting not

only in spoiling the insulation properties of the wood but also in creating rot. Small-sized United States tuna clippers which stow the tuna in ice for short range operations and have additional mechanical refrigeration, are only insulated under deck and on the bulkheads, but not on the inside of the planking. Refrigeration pipes are placed there and the fish is kept at a certain distance. In older vessels with complete insulation dry rot was very prevalent.

Penetration of water from outside can be prevented by the application of different oil-type paints. Shark oil is frequently used, but it has the disadvantage of being non-oxidising and therefore somewhat sticky. It is however certainly as good as more refined products such as linseed oil. Outside, under water, the hull is best impregnated with tar or creosote, on top of which some anti-fouling paint might be used. Painting the bottom is most important to prevent borers, and much improved anti-fouling paints are being developed, though creosote is supposed to be specially effective in preventing marine borer attacks. It must however be remembered that a spot where the paint has been removed is still unprotected and therefore periodic inspection of the boat is necessary.

Boats are often copper-sheeted to prevent marine borer attack. If intact, such sheeting is excellent protection, but if even minutely damaged it can give a false sense of security, as the marine borers can then penetrate and move considerable distances before they are detected. Copper sheeting is rather expensive. In India experiments are at present being made with aluminium alloy sheeting, which is considerably lighter than copper and also cheaper per unit weight. It is not known whether these alloys will stand up over a long period of time. Lately wooden boats have begun to be sheeted with glass reinforced plastics. This sheeting is also said to have strengthened bad old hulls. One difficulty in its application however seems to be that such plastic sheeting is difficult to fit to a surface previously well impregnated with tar or oil products.

Ordering a boat

When ordering a boat it is important to have detail drawings and specifications to avoid misunderstandings and unpleasant surprises at the time of delivery. Unfortunately many builders not used to working from detailed drawings might quote a higher price than for a boat which is described by an incomplete drawing or an incomplete specification; the builder could then be shown a similar boat and be shown that working from such a drawing might well mean less work as the shipwrights would know exactly how to proceed.

Once a boat is ordered, requests for changes in drawings or specifications should be avoided. A stipulation might be included in the contract saying that the builder undertakes to make any changes requested by the owner, but should he consider that these changes entail an increase in the contract price, then agreement must be reached on the extra price before work on the changes commences; or otherwise that he agrees to make the change without extra cost. If the owner submits drawings and specifies machinery, etc., one cannot require a guarantee from the builder regarding speed, stability, cruising range, or cargo capacity. If, however, the boat is to the builder's design, or if he proposes modifications in a design submitted "to improve it", or to give the boat a personalized ap-

pearance, he should naturally be requested to guarantee what the owner would expect from his own design.

In this connection it should be realized that speed and cruising range particulars are normally grossly exaggerated in regard to fishing vessels. If a fishing boat has happened to make a fast passage with a favourable tide and wind, the fisherman frequently uses this figure to claim what his boat is capable of doing. If then another fisherman happens to be able to pass this boat, the second man will immediately assume that his boat is some knots faster. The boatbuilder on simply hearing this, might easily claim that his boats make a very high speed. If such high speeds are then agreed upon in an order, great difficulties may arise on delivery when a careful surveyor would insist upon a realistic trial with and against tide and wind.

Boatyards are seldom in a position to finance construction, and boats have to be paid for in instalments. When deciding upon the timing of such instalments, it should be remembered that for a decked fishing boat with some accommodation and engine installation, framing and planking are rather minor parts of the complete construction. If too large advances are given at the stage when the planking has been completed, one might find that the builder loses interest in speedy delivery as soon as planking has been completed and he has collected the main part of the contracted sum.

The whole question of financing boat construction is, in fact, a most difficult one. If big advances are given, it can well happen that boatyards may be induced to give very low quotations so as to obtain the necessary advance money to repay old debts. In this way their financial status is undermined. They have no means of writing off old investments or of purchasing new labour-saving machines, and they soon find themselves at the centre of a vicious circle. Actually it has happened that owners, knowing this to be a weakness of many yards, have offered to pay higher advances than usual so as to get an unusually low quotation. In many countries boatyards have been very much influenced by the advance system and as a result the whole industry has remained at a very low level.

On the other hand, if investment in a boatyard is not too high and if, in helping boatyards to start construction, advances are given, good quotations, and thus cheap fishing boats, can often be had. A sound advance system should therefore not be detrimental to a boatbuilding programme, because without such a system it would be difficult for boatbuilders to establish themselves.

The practice of requesting a special deposit from a boatbuilder seeking an advance so as to furnish security against the advance, is not always practical. He can naturally mortgage his assets, such as his house, so that a bank can give the necessary guarantee of solvency, but it is not always so simple. This would hardly work in the East where the small industry fellows live in houses worth perhaps $50-$100. It should also be recognized that a boatbuilder has a right to have a guarantee from the owner that he can fulfill the contract.

One way of helping new boatbuilders establish themselves and obtain the necessary machinery, working capital, funds etc. might be by giving them a Small Industries Loan direct, thus supporting the boatbuilding industry by investment. The question of labour-saving devices versus cheap labour is really not so difficult. It is important to go in for

"time savers" such as electric hard drills, rather than for large investment machinery to cut manpower requirements. On the other hand any boatyards needs capital for houses, slipway, welding machines, and above all, to keep large quantities of materials such as wood in stock.

It is naturally important that careful inspection be made during construction to see that the design is closely followed, even in places which will later on be overbuilt. The knowledge that a surveyor is liable to visit the yard from time to time may also prevent a builder from growing careless about internal inspection.

To assist naval architects to make sound recommendations for size and type of new fishing boats required to meet new fishing conditions, Chapelle (1960) has suggested that fisheries officers collect data in the form of a questionnaire on the following lines on existing types and new requirements.

Fishing conditions

(a) Are grounds prolific enough to warrant possible expansion in catch?

(b) What mode of catching is considered most suitable?

(c) How distant are the fishing grounds from the fishing port?

(d) What are wind conditions in the fishing area and what are the usual sea conditions?

Operational information

(a) What types of boats and propulsion are in use?

(b) Is sail useful in the local fisheries, and can sailing boats be profitably employed for the present?

(c) What engines are now in use in fishing boats, and what is the price of fuel in litres or gallons?

(d) What fuels are available?

(e) Are fishermen now skilled in motor operation, boat or automobile?

(f) What lumber is used in local boatbuilding, if any; where and how is it obtained?

(g) What fishing gear is used, and what new gear is under consideration for new constructions?

(h) Are there piers, quays, harbours or coves giving complete shelter, or are beach-hauling operations required?

(i) What repair facilities are available? (Hauling methods, accommodation for heaving down; mechanical maintenance, sail making, marine hardware and supplies)

Economic factors

(a) Is the present demand for fish greater than the supply?

(b) Can demand be readily increased? Is market space available?

(c) Can fish be exported profitably? Is it being done now?

(d) Are cold storage facilities and canneries in existence?

(e) Is ice available for icing catch at sea?

(f) Is the existing fishery profitable with present gear and boats?

(g) Are improved pier and quay accommodation planned or under consideration?

Construction considerations

(a) Are boats built locally?

(b) Would improved boats be built locally or imported?

(c) Who would design improved boats, or how would such designs be obtained?

(d) Can local builders work from plans or half-model?

(e) Is there any formal effort to teach boatbuilding?

(f) Are improved boats or experimental boats under trial? What are the dimensions and power? If so, of what design; and are plans for half-models in existence?

(g) If improvement is now in progress, is it the intention to use standard boats in each fishery?

(h) Are sufficient fishing crews available to man boats larger than those now in use? Can labour cooperation be expected?

(i) Are there special safety requirements in view?

(j) How would improved boats be financed:

(1) By Government subsidies or loans?

(2) By private banks?

(3) By own savings and capital?

(4) By cooperative ownership?

(5) By rental or charter?

(6) By private ownership?

(k) Are there local taxes based on value of boat or catch?

Information thus collected could be illustrated with photographs, line drawings, and measurements of individual boat types. Plans would be most desirable, but are probably now unavailable except in cases of experimental craft now being tested. The questionnaire could be used as a permanent method of securing information on the individual problems of types of boats, and would also constitute an historical record on which to base improvements.

The importance of drawings

Most fishing boats are still being built without the use of scale drawings. This happens not only in so-called underdeveloped countries, where the explanation might be that the boatbuilders and fishermen cannot interpret boat drawings and transform them into the finished product, but also frequently in developed countries where builders and fishermen are literate, where they employ architects to design their own homes, and where they are used to reading engineering drawings for installing engines, etc. The fact that a boat is not built to scale drawings does not naturally mean that it is not built to a special design. It usually happens that a specific type has developed over the years with step by step modifications, and the builder and his shipwrights know the design by heart. In many cases a new boat is often referred to as being so much different from a previous one; in such a case the making of specific drawings and the building of boats from these drawings would take longer than modelling the new construction on a previously built boat.

As soon as many modifications have to be made, or a new type is to be built, or one has to employ different labour for different parts of the boat, or new labour not accustomed to the particular type of construction, then drawings are a very useful tool in planning the design and in having the work properly carried out. Also, when it comes to studying whether a specific type can be improved by introducing ideas from proven designs from other areas, drawings are the best help one can have.

Boat drawings frighten many people, as a boat is not square like a house, but has rounded shapes. Surprisingly little has been done to try to explain in a simple way to laymen the meaning of the most important of the boat drawings, namely the lines drawing, which des-

cribes the shape of the boat. People who have no difficulty in interpreting house drawings, or engineering drawings, are easily confused by the lines drawings. Fig. 2 shows a photograph of a half model which many builders make so as to shape their lines. This type of model is cut up – in the same way as one cuts slices from a loaf of bread – each individual slice representing the shape of the frame. If the slices are cut to the width of distance between the frames, one can then write what is called a body plan. Naval architects prefer to show the starboard side of their ships, i.e. having the stem to the right and the stern to the left, and they also show the sections of the foreship on the right side and the sections of the aft ship on the left (Fig. 3). Another way of illustrating the shape of the vessel might be to use two body plans – one for the foreship and one for the aft ship, and thus show both sides at the same time (Fig. 4 a-b).

The waterlines of a ship could similarly be illustrated if the model were cut up horizontally and the contours of these slices transferred to a common centreline. Similarly, other projections which are used, such as verticals and diagonals, could be illustrated (Fig. 5).

The lines of a boat can also be shown in a perspective drawing (Fig. 6). This might give a layman a better understanding of the shape of the boat, but unfortunately such perspective drawings can only be made once the lines drawings in the usual type of projections are ready, and have a pictorial value only, as no calculations or measurements for construction can be taken on it.

From the lines drawing it is also possible to make a number of calculations so as to see how much water is displaced at different draughts. Furthermore one can find out the centre of buoyancy of the hull and make investigations into stability. In determining certain proportions, relations and coefficients, an opinion can be formed as to how a specific hull compares with other hulls, and then draw certain conclusions with regard to resistance and powering.

Even if fishery administrators and extension workers cannot be requested to learn how to prepare boat drawings, especially lines drawings, it would be useful if they could familiarize themselves with the way in which such drawings are actually made, so that they could help boatbuilders to interpret drawings of new types and have the design transferred to full scale. Naval architects normally submit a table of offsets with the lines drawings, giving as sharp measures as possible regarding the distances from the centreline of a boat to the various waterlines, or from the base line to the sheer line, etc. These offsets are taken from the scale drawing and naturally if the scale is 1:10 then any mistakes in reading from the drawing, or any imperfections in the drawing itself, will be magnified ten times. Therefore it should be remembered that when the figures from the table of offsets are marked up in full scale, there will be unevenness, and it is up to the boatbuilder to fare the lines as nicely as possible.

Some design hints

Every builder, fisherman and designer wants his boat to look attractive and at the same time to be practical to build; safe, not too resistant, etc. For the ordinary designer, therefore, beauty is rather the result of having solved various problems than the main objective of his work.

A study of fishing boats from different places in the world reveals that

some correspond very well with most modern findings of naval architecture, but others do not. Fishermen and boatbuilders will naturally always try to justify the types they use so as to prove they have not been wrong in the past, but some remarks about hull design are in order here.

Boats can be divided roughly into displacement boats and planing boats. The displacement boats plough through the water, and the planing boat skims on top of it. A planing boat will first act as a displacement boat and plough through the water. When more power is applied, the speed will increase and so will the wave system, until suddenly, at a certain relation between length and speed, the boat will lift and skim on top of the waves. A displacement boat has not this ability to lift and plane. On the contrary, due to the forces playing around the hull, it will sink more and more, and possibly trim very heavily by the stern. Most fishing boats are already now so highly-powered that every knot extra speed would mean doubling the horse power, and in many boats the last 30 percent of the engine is not used at all. Fishing boats therefore work in the upper range of what is practical for displacement boats; for such speeds boats should have a sharp bow, the displacement should be concentrated midships and aft, the lines in the aft ship should be rather straight, and they should finish with a transom stern. The transom stern should be more V-shaped than the flat transom used on planing boats.

In order to have as good seaworthiness as possible, the freeboard should be high, and there should be a sufficient sheer line to bring the bow high up and make it possible to have a good flare in the sides of the foreship.

Full forebodies give the illusion of reducing pitch, but this is not the case. A lot of ballast and much beam naturally increase stability, but also reduce the period of roll – which means greater acceleration and a more uncomfortable boat. Unfortunately this is not easy to understand, and is seldom recognized. In addition, too little stability and too long a period of roll bring about great amplitudes and wetness, and therefore the happy medium period of roll seems to be the most adequate. One rule of thumb says that the boat should have the same period of roll as its width in metres. At the last FAO Fishing Boat Congress, Möckel (1960) suggested about 10 percent less period of roll than the width of the boat in metres. Checks with the behaviour of smaller fishing boats in the IPFC region indicate that these recommendations are very well-founded. Furthermore, if a ship has the period of roll suggested, it seems in most circumstances to be quite safe.

Classification societies

Classification societies exist to check the strength of vessels and to inform underwriters of the condition of ships, so that they could better determine their risks. They have established special criteria for different sized vessels and vessels designed for different purposes. In countries where adequate classification societies do not exist, governments have interested themselves in the strength of ships and formulated scantling regulations which in some cases are based on local circumstances and practices, and in others adopt the regulations of foreign classification societies. Such rules are mostly concerned with larger commercial ships, but some classification societies, such as Lloyds Register, and Norske Veritas of Norway, also produce special

regulations for pleasure yachts and motor boats. In other countries motor boat clubs have established scantling regulations for which they obtain approval from the authorities.

In some countries, such as Denmark, Sweden, Scotland and Newfoundland, special fishing boat scantling regulations have been made which are based on the regulations for cargo vessels. All such regulations have to guard against bad building. It is difficult to say what could be done to make rules that offer a premium to good builders, other than that the good builders are in a better competitive position in the long run. However, the conscientious builder who selects his timber very carefully, puts it together to fit well and impregnates it adequately, is, in a way, producing unnecessarily strong boats which cost too much in material.

All classification regulations for wooden vessels are actually empirical and very few strength calculations have been made on wooden ships. The Japanese have begun to do so (Otsu, Yokoyama and Kobayashi, 1960), but as yet there are no established rules for the strength calculation of wooden ships similar to those for steel ones. The classification rules are amended from time to time to take care of weaknesses and, due to the fact that all builders in a specific area normally build to the same set of regulations and therefore quote on the same basis, there have seldom been any efforts on the part of the builders to have these regulations changed, even when they necessitate heavy and expensive construction.

The United States is remarkable in so far as it has no regulations for fishing boats under 45.72 m. in length and thus boats have been built of very varying degrees of strength. Many complaints have been made about the bad construction of American fishing boats (Traung, 1955, pp. 385-389). The United States fleet has suffered many losses due to faulty construction, but many boats also have withstood the hazards of the sea for a great many years. There is a great demand for some voluntary standardization of design, and naval architects in the United States have held meetings to discuss what could be done to avoid Government regulations in establishing sound industrial practices. As an outcome of these meetings, Simpson (1960) analyzed the performance of some 22 successful fishing vessels of from 15.24 to 45.72 m.; he found that some were too heavily built and he proposed the minimum scantlings necessary for a long and successful life. At the recent second FAO World Fishing Boat Congress his proposals met with very great interest; a contribution by Gnanadoss (1960b) showed in particular that boats built according to the Danish regulations were about 40 percent heavier than the maximum recommended by Simpson. A similar contribution from Sutherland (1960) showed that larger Scottish wooden fishing boats were 46 percent heavier. The general conclusion drawn from this discussion was that much could be done to establish more economical scantlings than those specified by many of the present regulations. One participant even proposed a special Scantling Congress.

As FAO is committed to work for better practices in this respect, some technical meeting might well be required in the future. Such a meeting should probably concentrate on trying to include in the Simpson proposal boats smaller than 15.24 m. and also boats built with other types of frames than the sawn frames on which the Simpson proposal was

based. In this work, some use might be made of existing motor boat regulations and also there might be some advantage in trying to classify fishing boats for several duties. Naturally a boat working in the North Sea or off the American east coast is heavier stressed than one in the Pacific or in the IPFC region. For the time being, however, one is inclined to consider the Simpson proposals as being entirely safe for the range of the fishing vessels which they cover.

Examples of boat development

It is hoped that the above popular account of boatbuilding and boat design, and the highlights from the second FAO World Fishing Boat Congress, will give fisheries administrators some insight and understanding of the problems to be met and also some hints on how to judge boat designs. Most fisheries administrators have already a great interest in boats, being the most important part of the whole industry, and the technique of designing boats is actually not at all very involved, even if one does have to follow certain established principles. The Indian training centres for boat designers proved that it is possible to train intelligent men rather quickly in the method of making simple boat designs.

However, in practice, the development of a boat takes more time than is perhaps understood. It is simple to design a boat, but it is difficult to develop a boat which, subject to a very critical review, will combine the best of everything. When the first FAO/ETAP Naval Architect went to the south of India in 1953, the boats in use were mostly catamarans and dug-outs which were difficult to modify into modern fishing boats. Something quite new had to be developed.

FAO had already shipped two small Danish built boats to India for use by their Fisheries Engineer for his first experimental fishing. These boats were not intended to constitute the ideal type for India but merely a vehicle from which the Fisheries Engineer could handle his gear. They had naturally more capacity than the local boats and proved to be more efficient, with the result that there was soon a keen demand for new boats. The FAO Naval Architect was immediately asked to produce a design and, happily enough, he had with him a design of a boat, something similar to the Danish ones. The boat was also designed with a cruiser stern, like the Danish boats, which up to about that time had been considered the ideal stern for fishing boats. The FAO Headquarters Naval Architect proposed that this should be modified to a transom stern, not only in order to improve efficiency, but also to reduce the cost of construction. It was felt that because the local canoes had a pointed stern, and the Danish boats a cruiser stern, this would however be too great a departure from custom, and thus the first boat built in India had a cruiser stern. It was called *Pablo*, that being the Spanish version of the Naval Architect's first name, and it was rather interesting to see how this name came to represent any mechanised boat. Several boats of this type were built, and proved most successful.

In time it was felt that investigations should be made as to how the Pablo boats could be made somewhat less expensive. It was argued that with a transom stern the boat could be made somewhat shorter, and it was proposed that the freeboard be increased to obtain the same carrying capacity as the 7.62 m. prototype boat. Thus a 6.70 m. boat was developed in 1956 and one boat built from the design. Tests revealed that the boat

was too top-heavy because of the high freeboard and the high working floor, and not very pleasant to work from. The lesson to be drawn is probably that when the boat designers give in to the understandable demands from the users for a high freeboard to obtain large capacity, a less successful boat will probably result.

When the third FAO Naval Architect went to India in 1958 the plans for modernisation of the Pablo boat were again discussed. As it had then been found in India that somewhat larger fishing boats with transom sterns built according to FAO designs in India had behaved very satisfactorily, it was decided to design a new 25-footer (7.62 m.) with a transom stern. A special study of the fishing conditions was made, as well as of the experience gained from the Pablo boats, and in March 1959 eight boats of the new type were under construction. As soon as the first boats were built their performance was studied and the design was again revised. Thus in the summer of 1960 it was felt that the 25-footer (7.62 m.) had been developed so far for Indian conditions that it justified production in large quantities, and a special handbook covering the construction and use of this type of boat was produced.

It might seem that seven years is a very long time in which to develop a 7.62 m. boat, but it must be remembered that the boat was introduced into a complete new set of conditions when new fishing methods had to be developed, and boatbuilders had to be found to build planked boats, where materials had to be selected and the right engine types chosen. Furthermore it must be remembered that the difference in efficiency between the first boat built in 1953 and those built to the new design is considerable.

Another similar time-consuming boat development project is that of the beach boats. The Director of the FAO Fisheries Division visited India in 1949, assessed the situation and found that it would be of great advantage if, alongside the development of harbour-based craft of various types, a mechanised craft could be developed that could be operated from the surf-beaten beaches. The first FAO Naval Architect visited India for the first time in 1951 and was shown typical surf operations of catamarans in the neighbourhood of Madras. At that particular time the surf was breaking directly on a steep beach and the catamarans were landing with a very heavy impact. The size of the breakers was considerable, and it was advised that the development of the new craft should proceed very carefully.

In 1952 an FAO Fisheries Engineer visited India and watched surf operations at a flat beach with a bar far outside. He found that launching and landing on the beach would not be difficult, but the difficulty would be in negotiating the surf breaking over the bar far out. He felt that a boat able to operate between the bar breakers and the shore line, and able to negotiate the bar breakers at a convenient moment, would be the ideal selection, and that the design of such a boat would not create any great difficulties.

His observations and those of the Naval Architect were quite different, and it was impossible to reconcile their views.

In 1953 the first ETAP Naval Architect went to India, when he had occasion to study different locations and different sizes of surf. He felt that a beach boat would have to be very small and light so that it could be man-handled by local crew. He also had some difficulty

in finding boatbuilders able to build very lightly and yet strongly. In 1954 the first prototype was built in Madras, 6.09m. long, 1.75 m. wide, and 0.635 m. deep. The boat was equipped with a water-cooled engine but very soon sand got into the cooling system, which created difficulties in operating the engine. The boat was rather successful in negotiating moderate surf, but was still too heavy for easy beach man-handling. A second, lighter prototype was therefore designed in 1955 and the first boat from this design was tested in late 1955. This was 5.56 m. long, 1.65 m. wide and 0.609 m. deep. It was equipped with a 3½ h.p. air-cooled engine, which proved to be on the low side, and fishing trials showed that such a small boat was not an economic proposition as the fisherman could not bring sufficient gear for a profitable catch.

In the spring of 1956 three such boats were tested with different engines, and although it was already known that the boats were too small for the purpose, it was thought important to carry out tests with different engines and different arrangements of keels, beach handling etc. and to regard the whole trial as a kind of model test. Valuable experience was gained during the trials, and subsequently work began at FAO Headquarters in 1956 on the development of a larger beach boat, 7.31 m. long, 1.94 m. wide and 0.787 m. deep. Unfortunately it was impossible to obtain the money to have a prototype built, but in the meantime the drawings were sent for comment to a number of FAO field workers and to naval architects in many countries. Subsequently a new design was prepared in May 1957 and in 1958 two boats were ready, one having been built by FAO in Ghana, West Africa, and the other by the Indian-Norwegian Fisheries project in Norway. Several tests were made, both in Ghana and India in 1958. In that year also a Symposium – "The Boat and the Beach" – was held at the INP camp in Quilon, India, where the whole beach boat problem was thoroughly discussed.

In the meantime the INP had also been working on the problem and had developed certain other types. It also became known that waterproof marine plywood was being manufactured in India, and it was felt that a mass-produced plywood surf boat would be cheaper to build than the roundbottom, clinker-built boats so far used. A boatyard in Bombay had also devised a method of combining marine plywood with glass fibre reinforced resin, and a boat was designed which was completed in the summer of 1959. After several trials with roundbottomed FAO and INP-type boats, it was decided to have a large-scale testing programme during the winter of 1959/60. The boats were tested at Tuticorin, Madras and Puri, Orissa, and the draft report of these tests reveals a number of interesting conclusions and recommendations for future designs.

One conclusion is that surf varies, due to the slope of the beach, and the observations of the Naval Architect in 1951 as well as those of the Fisheries Engineer of 1952 were each in their own way correct. Conditions in the same place also vary, because the beach slope changes, and the ideal beach boat must therefore be so designed that it can be operated under both conditions. Surf conditions are comparatively much worse in India than in, say, Denmark or Portugal, where boats are often launched stern first, and the Indian experience has shown that boats must be designed so that they can be launched with the bow first. The general hull form must have a sharp forebody,

transom stern and the centre of gravity far aft. It is a difficult problem to design a boat with shallow draft so as to be easily operated close to the shore and over the bars, but at the same time having a propeller with sufficient diameter to give the necessary thrust during operation. The optimum location of the propeller is under discussion. A centrally located propeller will have a smaller diameter and thus less thrust than a propeller located on the side of the keel. An engine installation with side installation will be more flexible than one with a centre installation. In addition the keel structure is strengthened. There is more danger of the crew being injured with a side installation and that fishing gear gets entangled on the side where the propeller is fitted. On the other hand, the crew and the gear on the far side are more protected. The first beach boats with side installations had their engines installed off centre. This had the advantage that one could arrange good communication alongside the engine from the aft cockpit to midship of the boat. It had however the disadvantage that the hull was not well balanced, and upsetting forces could create difficulty during surf operation. A solution has been suggested whereby the engine could be fitted midships at an angle to the centre line of the boat so as to permit side installation of the propeller only. Due to the first difficulties with water-cooled engines in 1954, air-cooled engines were used in subsequent prototypes. There were certain difficulties in installing these air-cooled engines because of the complicated but necessary cooling air-duct system, and it was also found that if a boat capsized and sea water came into contact with the hot engine block, cracking might be the result. It may be likely that the ultimate choice of engine should be water-cooled, but that the cooling of the water should be done in a special radiator such as that used on motor vehicles.

Boats made of plywood seem to be the strongest and the cheapest to manufacture—at least in large quantities. The patented method of binding side and bottom panels of plywood with glass fibre reinforced resin limits its use to specific shipyards with a licence. On the other hand, it might perhaps be well to consider the orthodox connection of these panels by heavy chine stringers and inside knees.

The story of the development of individual fishing boat types in the Indo-Pacific region could certainly be much longer if written up in detail. These two examples are only given to show that boat development is a slow, and perhaps never-ending, process.

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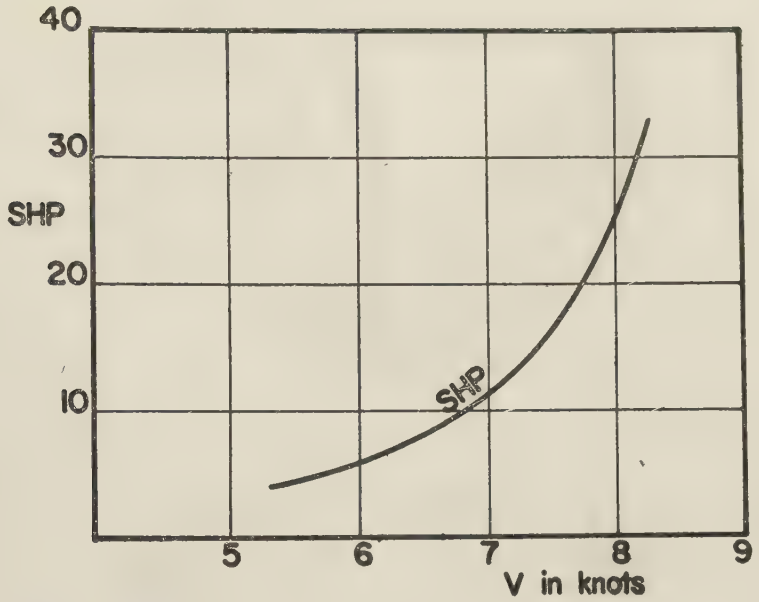

Fig. 1

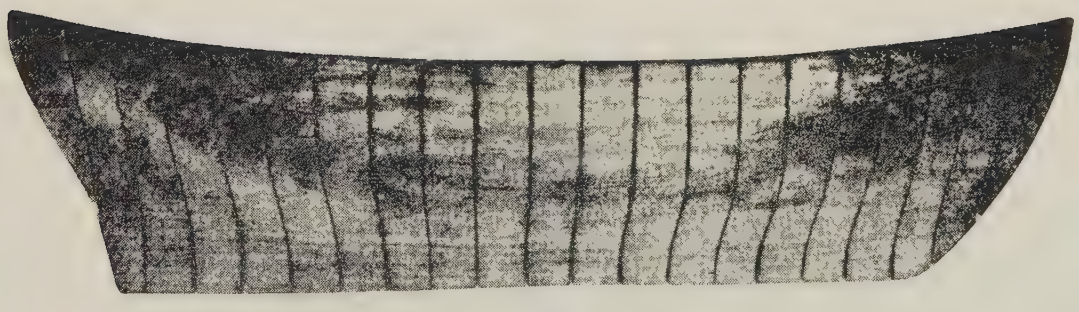

Fig. 2

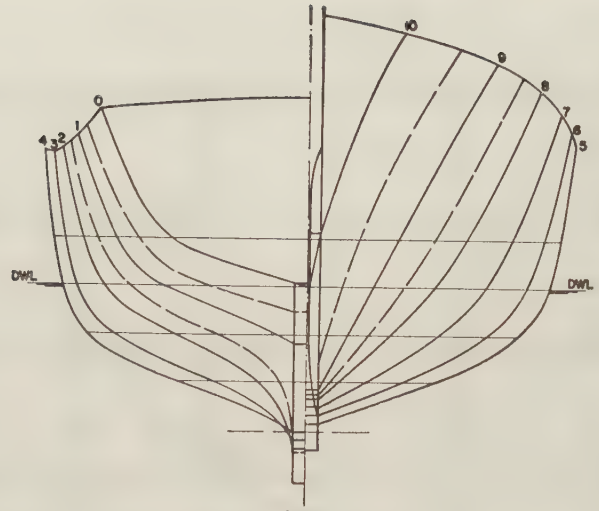

Fig. 3

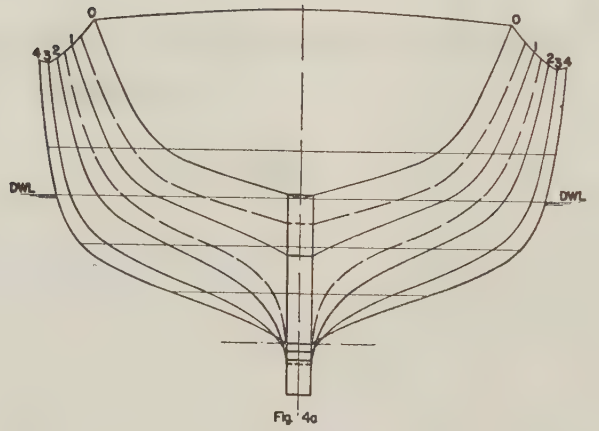

Fig. 4a

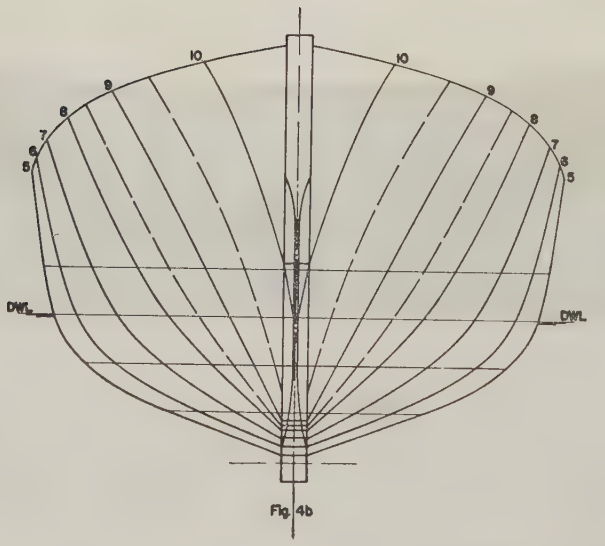

Fig. 4b

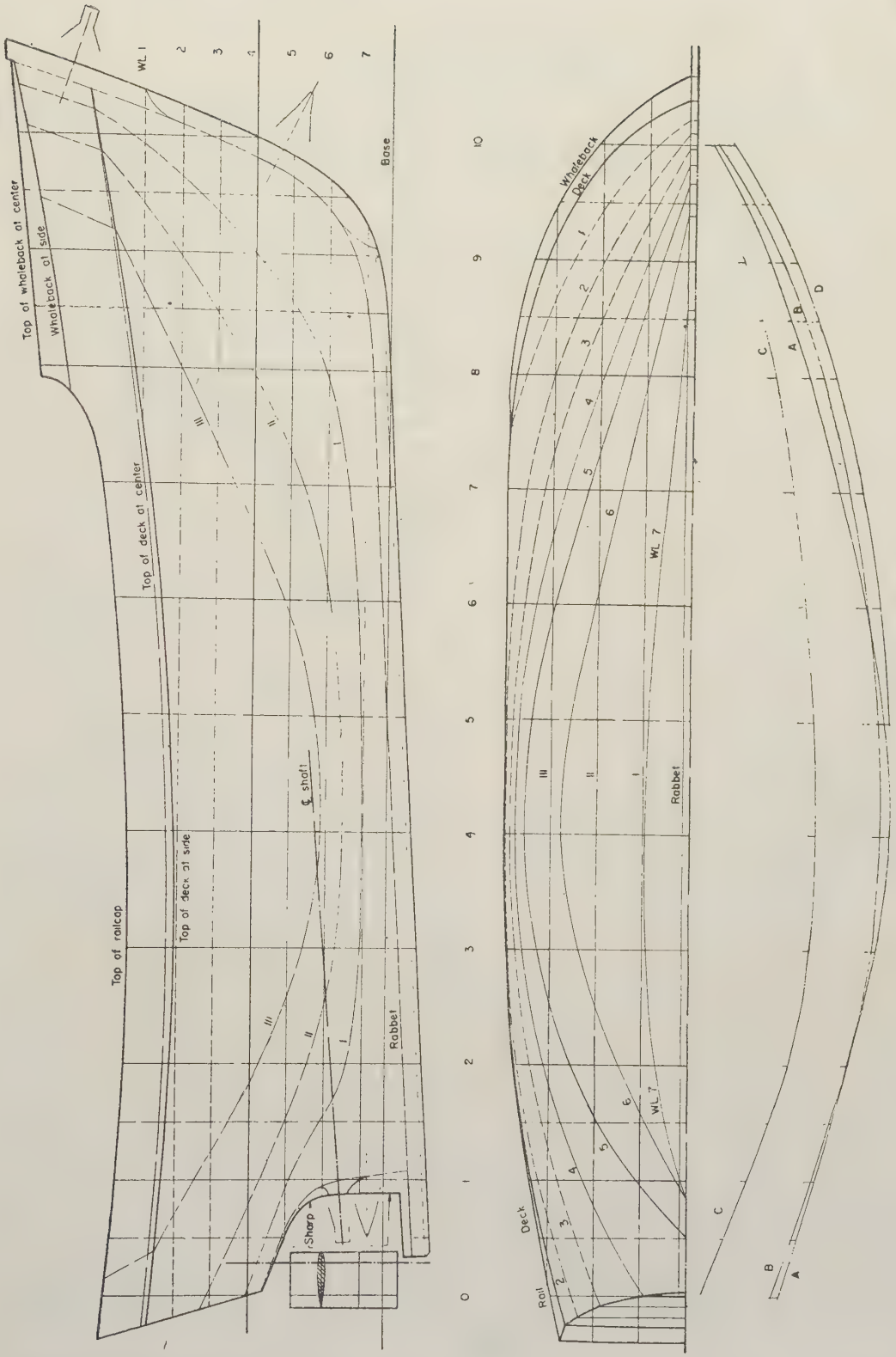
Top of whaleback at center
Whaleback at side
Top of deck at center
Top of deck at side
Top of railcap
WL 1
Base
Rabbet
Sharp
Whaleback Deck
WL 7
Deck
Rail
A
B
C
D

Fig. 5

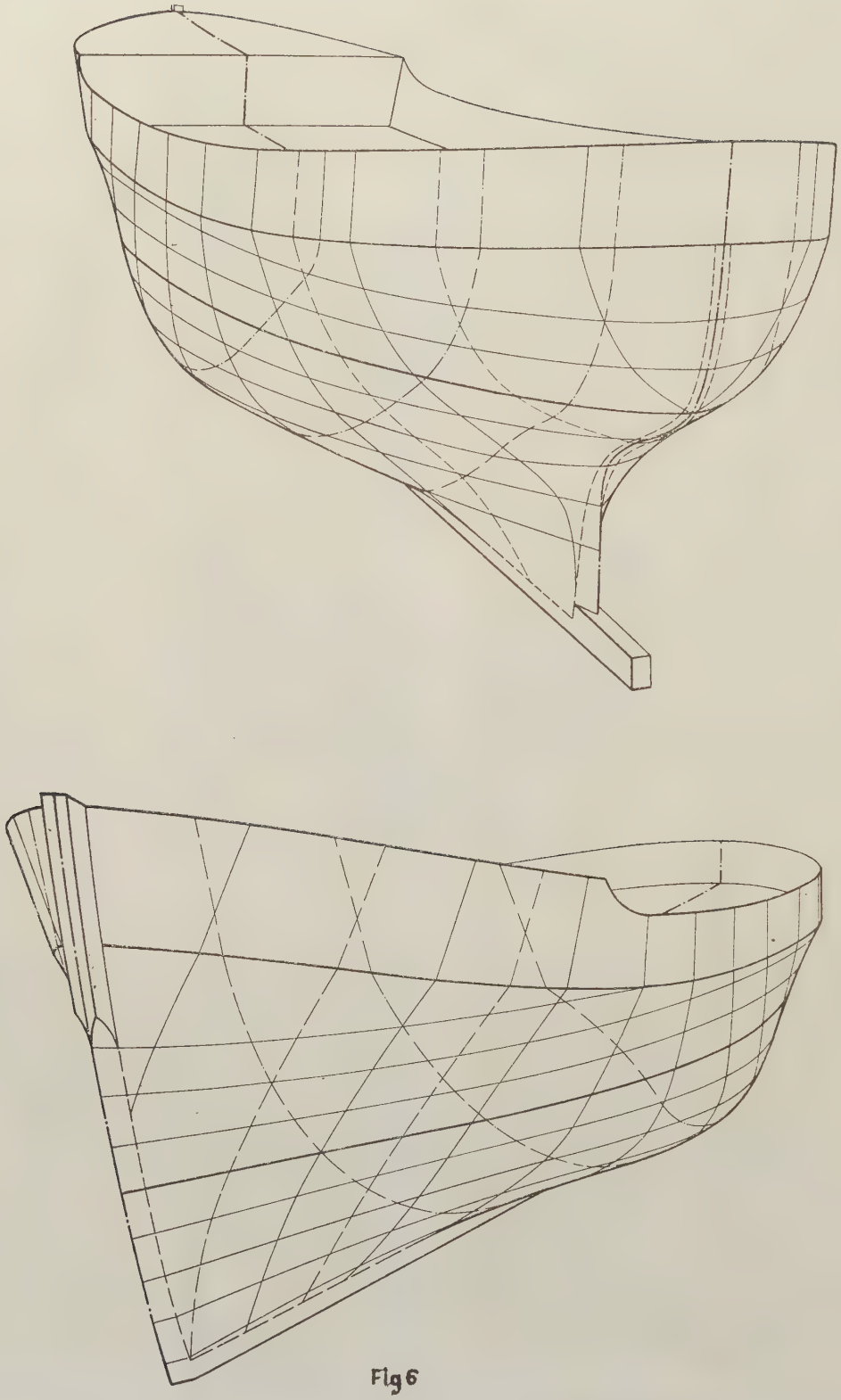

Fig 6

Radioactive Contamination in Lakes

A Swedish west coast fishery research scientist for some years has been engaged in investigating the effect of the radioactive outflow from atomic reactors on water in Sweden. The biological effects of the radioactivity level in Lake Tvaren, which serves as the outlet for the atomic research institution at Studsvik are being studied. This check will be made by the Swedish Fisheries Board and the Radio Physical Institution, the latter being the top organization in Sweden concerned with protection from radioactivity. Similar control is also planned for Lake Magelungen, the outlet for the Agesta reactor, which will be Sweden's first atomic reactor for industrial use. (*Comm. Fish. Rev.*, Aug. 1960).

Oceanographic Research

UNESCO's marine sciences programme which was started several years ago will reach a new level of expansion in 1961-1962. Following the inter-governmental conference on oceanographic research (Copenhagen, July 1960), it is now proposed to establish an inter-governmental oceanographic commission within the framework of UNESCO. This Commission will consist of representatives of countries willing to participate in carrying out oceanographic programmes which require concerted action. Typical examples of such action would be: establishing standards and planning other necessary measures for oceanographic surveys, setting up of oceanographic recording stations, and co-ordinating existing stations into an international network. As mentioned before, the special committee on oceanographic research of the International Council of Scientific Unions will serve as a scientific advisory body to the new Commission in carrying out its duties. At the same time, UNESCO will establish within its Natural Sciences Department, an office of oceanography which will provide the Commission with secretariat services and will expedite arrangements for the carrying out of surveys by participating countries.

The largest undertaking in which UNESCO will collaborate under this programme is undoubtedly the International Indian Ocean Expedition, planned by the Special Committee on Oceanographic Research, which will last for a period of four years, bringing into co-operation 14 nations and 20 oceanographic vessels. Furthermore, UNESCO's own programme for research and training of specialized research personnel in the field of marine sciences will be considerably intensified, and a study will concurrently be made on the desirability and feasibility for UNESCO to charter an oceanographic training and research vessel. (*UNESCO Information Bulletin*, No. 10, Nov. 1960).

Paddy-Cum-Fish Culture

Commencing in 1955, the Bihar State Fisheries Department (India) has conducted some 350 field trials to determine the efficacy of fish culture in rice fields. Suitable precautions to ensure adequate depth of water, minimal influx of undesirable fish species and control of predatory birds were taken. Early experiments revealed that the most suitable size of fingerlings for stocking was about 5 cm. and three species, *L. rohita*, *C. catla* and *C. mrigala* were used. Results indicate an increased yield of rice from 3.5% to

20% (av. 10%). With a stocking rate of 500 fingerlings per acre, 20% survival was achieved, the yield being up to 90 kg. per hectare (av. 45 kg.). Maximum sizes attained during 3½ months growing period were *L. rohita* – 208 mm; *C. catla* – 241 mm.; *C. mrigala* – 152 mm. *C. mrigala* appeared to thrive best. Use of chemical fertilizers in the rice fields did not harm the fish, but insecticides, without distinction, wherever applied were found to reduce the fish population. (*Personal Communication*).

Tropical Fish Culture

The proposed programme for three years 1960-63 of the Tropical Fish Culture Research Institute, Malacca, Federation of Malaya, include the study of the effects of fertilizers on fish production, using a 6 × 6 Latin square of one-acre ponds. Biological and chemical variations will be correlated with this. The "Living Space" concept will be studied using ponds divided into ½ and ⅔ by wire-netting and stocking at 4 different stocking rates. A critical study will be made of the spawning conditions, spawning cycle and the induction of spawning in *Ctenopharyngodon idellus*, *Catla catla*, *Puntius javanicus*, *Tilapia mossambica*, *T. zillii*, *T. melanopleura*, and *Osphronemus gourami*, including studies of the physiological and endocrinological changes. Genetical research will cover the cytology and genetics of the *Tilapia mossambica* cross, and attempts will be made to cross *T. zillii* with *T. melanopleura*. Selection work will be carried out on many species of fish held at the Institute.

The study of foods will include conversion ratios, food chains and the biochemistry of the digestive mechanisms.

Paddy fields are to be made to study the cultural conditions for the rearing of *Trichogaster pectoralis* and *Trichogaster trichopterus*.

In the laboratory, chemical, physical and biological work will cover the identification of organisms, analysis of cultural and natural conditions, oxygen demands etc.

Manatee

Since 1885 the Botanic Gardens in George-town, British Guiana, has had in some ornamental pools manatees (*Trichechus manatus*, order Sirenia), which have been always fed with grass by visitors. These pools have been kept clear by the manatees and it seemed always necessary to get additional food in the form of grass. It was therefore felt that experiments should be proceeded with using these animals for weed control, and some have been maintained in the reservoirs of the water purification plant and have effectively kept these clear of aquatic plants, particularly *Cabomba aquatica*, *Anacharis*, *Leersia*, *Utricularia*.

The manatee is not merely an occasional but also a very voracious and determined grass feeder, which can in fact clear trenches which are covered with grass or *Nymphaea*, *Nelumbo*, *Eichornia*, as well as submerged aquatic vegetation, and they have been doing a very commendable job in confined areas. During 1959-60 several experiments were carried out, and it has been found that two manatees 2.3 m. long were capable of clearing a canal 6.7 m. wide and 1,463 m. long in 17 weeks. They will also keep it clear of weeds to allow the free passage of water and will break any wood barrier fixed across the canal in order to get at grass beyond the barrier. These animals are not numerous, they are perfectly docile, easily bruised and seemingly very slow in reproduction. About 46 of these ani-

mals have been collected so far, and they have been distributed in several canals of drainage and irrigation schemes throughout British Guiana. They are found in the rivers of British Guiana and are caught by fishermen in seines, but can easily be drowned. Much information has been collected on their anatomy through the University of Florida though much more information is desired on their ecology and reproductive habits.

As a means of water-weed control, the use of these animals is far more effective and lasting than the usual chemical weedicides. They are harmless to fishes and other water animals, and are seemingly unaffected even by electric eels which are normal inhabitants of some of the irrigation canals into which these manatees were introduced. The only risk in their wide use is that they may be slaughtered for their meat; legislation in British Guiana is now being enacted to ensure their complete protection. (From *Nature*, 26 Nov. 1960. W.H.L. Allsopp, Fisheries Laboratory, Department of Agriculture, P.O. Box 174, Georgetown, British Guiana. The Manatee: Ecology and Use for Weed Control).

New British Trawler D.B. FINN

The D.B. FINN, a distant water trawler, named after the Director of FAO's Fisheries Division, has been launched at Goole, England. The boat was christened by Mrs. D.B. Finn, wife of the Director. The ship is equipped with all the modern aids to fishing in their most advanced stage, so that the skipper will be able to exercise push button control over his vessel. She has automatic steering, gyro compass, direct engine control, fish finding instruments, two radar sets and a radar track indicator, an electric log, plus switches for stopping the winch, etc. The new trawler has a bulbous bow, developed after extensive tank tests done in collaboration with the National Physics Laboratory at Teddington. It is expected that, with this type of bow, the ship will have a speed in excess of 15 knots. Built by the Goole Shipbuilding and Repairing Co. Ltd., the D.B. FINN has an overall length of 61.72 m. and will accommodate a crew of 31. She is designed for starboard fishing only and contains 516.78 m^3 for storing fish.

Underwater Television

Biologists at the Woods Hole Biological Laboratory of the U.S. Bureau of Commercial Fisheries now are able to extend their studies with the help of underwater television to include observations of fishes as they are caught in otter trawls. The specially-designed television camera is suspended with the cod end of the trawl and the image transmitted over a coaxial cable to a receiver on board the vessel. Continuous observations or motion picture recordings of the fish in the submerged net can be made by biologists in the comparative comfort of a ship-board laboratory. A major problem in gear studies has been the behavior of fishes in the trawl. Do the small fish actually try to escape through the meshes, as the biologists hoped they would? Do trash fishes clog the meshes, thus blocking the escape of immature cod fishes? Underwater television will now help to supply answers to these and other questions. Careful analysis of motion picture recordings of the television screen has uncovered some interesting facts of species differences in behavior. For example, haddock seem to explore the confined area within the cod end, crossing from one side of the trawl to the other. In contrast, sand launce, an important marine forage

species, seem in a hurry to escape through the meshes and usually do so in very rapid fashion. Many future underwater television studies are planned by the Woods Hole Laboratory. One such study will examine the relationship between the swimming ability of fishes and the speed of the trawl moving over the ocean floor. (*Comm. Fish. Rev.*, Aug. 1960).

Fishing with Light

The coastal waters off southern California from San Pedro to Palos Verdes Point, and Santa Catalina Island were surveyed (16 May-4 June, 1960) by the California Department of Fish and Game research vessel ALASKA to test the effectiveness of several types of lights for attracting gish, and to experiment with new methods of setting fish-sampling nets. Tests were conducted on 28 stations to determine the relative effectiveness of fish attraction of underwater colored lights compared with the regular 1500-watt incandescent standard sampling light. A 500-watt underwater lamp with interchangeable colored filters was used. The two lamp types were used separately on alternate stations. Stations were located in clear water where fish were known to be present. At 22 of the 28 stations a blue lens was used alternating with the standard 1,500 watt lamp. The blue lens attracted sardines on 2 of the 11 stations at which it was used, jack mackerel on 2, and Pacific mackerel on 1. The standard light attracted sardines on 5 of the 11, jack mackerel on 2, Pacific mackerel on 1, anchovies on 1, bonito on 1, and Atherinids on 4. In the remaining 6 tests, an underwater amber lens attracted sardines on 1 of the 3 stations at which it was used. Sardines were also attracted to 1 of the 3 alternate standard light stations. To test the effectiveness in catching fish under different colored lights, fish were attracted with a surface light, an underwater light was then turned on and the surface light extinguished. Observations of fish behavior were then made. On each station the amber, blue, clear, and red lenses were used. Fish behavior was not noticeably altered by the amber, blue, or clear lenses. A milling school of sardines or anchovies under the surface light continued to mill in the same pattern when the underwater lamp was lighted and the surface light extinguished. When the red lamp was turned, sardines, in each case, left the red light zone. Reaction to the red light may have been a function of low light intensity rather than a response to the red color. Sardines did not avoid the red light zone when an overhead incandescent lamp was turned on simultaneously. None of the underwater lenses tested altered fish behavior to the extent that it made them more susceptible to capture. However, when sardine or anchovy schools were given a preference, invariably they were attracted to the brightest light source. A sampling gill net was set on 5 schools of "wild" sardines which were extremely difficult to catch with the blanket net. Sardines were obtained on each set. The degree of "wildness" in sardines varied between schools. The presence of bonito, barracuda, sharks, and other predators considerably increased the degree of "wildness" in a school. (*Comm. Fish. Rev.*, Sept. 1960).

Trawl Doors

In Taiwan, a new type of trawl door has been developed which has a flattened V-cross section. The following is a discription of the new type of trawl door:

Its V shape, with the convex side fished inboard. The main towing cable is fastened to a semi-circular steel bracket

which is in turn fastened to the board at two points instead of at four points as conventionally. No other material is used besides steel plates, pipe and bar.

The advantages of the new type of trawl door are as follows: When trawling in soft bottom, these otter boards never dig into the mud. The board does not tumble, (Tumbling of trawl doors is not unusual, especially when trawling on one side of the vessel. It results in closing down the head line of the trawl, and therefore, closing its opening). Adjusting of the towing center of the board becomes simplified to great extent. Once the adjustment is made, it remains fixed and unchanged by any rough handling or twisting. Left and right boards can be exchanged at anytime in only a matter of five to ten minutes. There are two rows of holes on the bracket for this purpose. The V-shape otter boards are able to open up the wings to a larger spread than the conventional doors do. This angle of opening can further be adjusted easily by shifting the main cable fastenings on the brackets. Steering and turning are found to be easier to perform with V-shape boards than with conventional plain boards. V-shape board is lighter in weight than conventional board, yet there is no worry of its being raised from sea bottom. V-shape board does not hook on bottom obstacles such as rocks and wrecks. When encountering obstacles the board simply flips on its axis of the hinged bracket until it clears the obstacle. Handling of such a door is simple, and it is easy to construct, hence the cost is low. Catch is found to increase because of the wider spread of the wings.

Size of the V-shape board varies with the use on different trawlers. For instance, a 3.72 m^2 design was first experimented on M.V. PAHAU by the designer while a 2.60 m^2 design was later experimented on a smaller vessel, the M.V. YUNG JA, both with equally satisfactory results. PAHAU is a 280-ton steel hulled craft with 550 hp., dragging on one side after the Atlantic manner. She fishes 3.72 m^2 doors on a trawl 500 meshes of 11.4 cm. around the breast, 33.53 m. head-rope. YUNG JA is 136 tons, steel, 240 hp., and works as a Pacific style stern dragger with 2.60 m^2 doors on a net with 400 meshes of 11.4 cm. and an 24.38 m. headrope.

Knotless Nets

A firm in Bremerhaven, West Germany, has begun production of a knotless ocean fish trawl net. The German Institute for Gear Research in Hamburg had good experience with the trawl when it was tested on the research vessel *Anton Dohrn* during a trip to the Barents Sea. The factory began its experiments in the manufacture of a knotless trawl in 1955. The firm has been able to guarantee uniform mesh widths. It adapted a machine now used for the manufacture of curtains, shirts, upholstery material, etc., to plait or braid threads together in the same manner as curtains to produce a knotless fish trawl in only three hours. The method already has been patented. (*Fiskaren*, 8 June 1960).

Antibiotics

During recent experiments on the storage of herring over a 21-day period in normal ice and in ices containing chlortetracycline and oxytetracycline, an attempt was made to correlate changes in the bacterial flora with some of the changes which occur in the muscle. The antibiotics did not affect the rate of production of the lower volatile fatty acids

but the free amino-acids, estimated by the method of Moore, Spackman and Stein, showed changes. The changes occuring in the amino-acids followed a regular pattern. Proline, methionine, threonine, alanine, glutamic acid, lysine, valine, isoleucine and leucine showed a gradual increase up to around the fourteenth day, followed by a decrease. Phenylalanine, tyrosine and serine showed little change, while histidine, arginine and possibly glycine decreased steadily throughout the period. In the cases where the amino-acid content changed over the period, there was always a larger residue in the treated, compared with the untreated, fish, this difference being greater at 14 days than at 7 days. Bacterial counts were lower on the skins of treated compared to untreated fish. There are three possible explanations for these observation: (1) the activity of the selected bacterial flora may be greater than that of the flora on the untreated fish; (2) the selected flora are primarily proteolytic (*Pseudomonas* spp. and *Achromobacter* spp.), and even if their overall activity is not increased relative to the untreated fish, accumulation of amino-acids may occur due to the reduction of other groups which utilize them; (3) autolysis in the muscle may continue independently of the bacterial flora, amino-acids thus formed being utilized by bacteria. Reduction in the number of bacteria due to the presence of the antibiotics then leads to an accumulation of the acids in the treated fish. There is reason to believe that the flora selected during antibiotic treatment is less active biochemically, particularly in the presence of the antibiotics. Many enzyme systems are also depressed by antibiotics. Thus it is unlikely that increased proteolysis occurs during antibiotic treatment, and it is therefore possible that the increased accumulation of the amino-acids in the treated fish was due to reason (3), the acids being produced antolytically, and their rate of accumulation governed by their assimilation rather than their production by bacteria. Furthermore, the observation that the increase in the amino-acids occurred during the first fourteen days of storage-before the stabilization of the dominant bacterial flora-again indicates that during the critical early stages of spoilage, proteolysis proceeds independently of the bacterial enzymes. (From *Nature*, 19 Nov. 1960: Nihal N. de Silva and R.B. Hughes. Effect of Tetracycline Antibiotics on the Proteolysis of Fish Muscle.).

New Canned Tuna Product on Market

A new canned tuna product, "Tender Tuna", which a Japanese processing firm put on the Japanese market late in June 1960, is enjoying good acceptance. Consumption has been about twice as high as expected. Characteristics which have made the new product a hit with the consumers are: (1) the flavored oil and water sauce in which it is packed can be used in cooking as a flavoring agent; (2) it has a distinctive flavor and a tender texture; (3) it is processed so as to resemble chicken; (4) the tuna meat is packed in the form of blocks; (5) no fish design is used on the label; and (6) it is comparatively cheap. At present the product is put up in flat No. 2 and No. 3 cans in four different flavored sauces: soy, tomato, stew, and curry. The No. 2 can sells at retail for 55 yen and the No. 3 can for 35 yen (approximately 15 cents and 10 cents, respectively). (*Comm. Fish. Rev.*, Oct. 1960).

NEWS FROM THE REGION

NORTH BORNEO

The first consignment of frozen fish from British North Borneo to the U.S.A. was shipped in June 1960 by a North Borneo trading company. A Japanese firm has revived the prewar Japanese fishing operations on Si Amil Island off the Semporna Peninsula in the Celebes Sea area of North Borneo. Pending reconstruction of the canning and processing factory on the Island, factoryship, the GINYO MARU, which has cold-storage facilities, had anchored off the Island for processing operations. Reportedly, 300 Japanese fishermen and technicians are operating 30- to 40-ton trawlers in deep-sea areas in the surrounding waters. A 1959 Japanese economic mission to North Borneo seems to have been successful in reviving the fishing industry. (*Comm. Fish. Rev.* Aug. 1960.)

There is very little information on the landings of fish and shellfish in the North Borneo. However, some statistics are maintained on the export trade in marine products. In 1959, North Borneo exported about 2,000 tons of marine products valued at about US $491,000. As compared with 1958, the exports were higher by about 600 tons in quantity and US $88,500 in value. Marine fishing in North Borneo (in the past mainly confined to inshore waters and estuaries), with an increase in use of power boats, has now been gradually extensed to offshore waters. Three different methods of deep-sea fishing have been introducted and of the three, otter trawling is firmly established as catches have been and still are good. The other methods, namely: beam trawl for shrimp and rod-and-line fishing with use of live bait for tuna, have only been tried out recently and catches so far proved satisfactory. Trials on the use of the Hong Kong-type beam trawl for shrimp were carried out in the areas outside Sandakan Harbour. Results have been found to be promising. A 210-ton Japanese tuna vessel, complete with live bait for bonito and tuna fishing with pole and line, arrived about June 1960 to try out fishing in the areas South of Si Amil Island. Catches have proved extremely good. Species of tuna caught were mainly skipjack or striped tuna and a small percentage of yellowfin tuna. Fourteen fish ponds (covering a total of 1.62 hectares) were constructed and stocked during 1959. The majority were situated in the Keningau and Tenom districts. Total number of fish ponds in North Borneo at the year's end was 660 covering an area of 17.85 hectares. Total production of pond fish in 1959 was estimated at 18 tons. Retail prices for goods pond fish (sold alive), although varying between different districts, was generally high. This, combined with a steady demand, did much to encourage the industry.

Yield of *Tilapia* in "monosex" culture increased from 2,091 Kg. to 2,391 Kg. per hectare per year by adjusting the stocking rate. More and more fish farmers are adopting this method; there were 1.82 hectares of ponds in Keningan and 1.1 hectares in Tenom stocked with male *Tilapia* at the end of 1959. (*Comm. Fish. Rev.* Sept. 1960).

HONG KONG

Administration and Policy. It is the aim of the Government of Hong Kong to foster the orderly expansion and development of the Colony's Fishing Industry, to increase supplies of fish to meet the needs of an expanding population and to enchance the economic status of those engaged in the industry. A Fisheries Division was established in 1952 under the administration of the Agriculture and Forestry Department and, in the same year, a Fisheries Research Unit was formed by the Hong Kong University. Matters of common interest to the Fisheries Division and the Research Unit were co-ordinated through a Fisheries Advisory Committee on which both were represented as was also the Co-operative Development Department which was responsible for the supervision of fishermen's Co-operative Societies and the administration of the Fish Marketing Organization.

The disadvantages inherent in this divided responsibility were such that it was decided that a single authority should be set up to direct fisheries activities; in July 1960 the Fisheries Division was transferred to the re-designated Co-operative Development and Fisheries Department and was joined one month later by the Fisheries Research Unit, now known as the Fisheries Research Station. As fresh water pond fisheries in Hong Kong are closely connected with land utilization, it was decided that extension work in respect of commercial fish ponds should remain with the Agriculture and Forestry Department, although basic research work in connection with pond fisheries is the responsibility of the Co-operative Development and Fisheries Department.

Marine fisheries extension activities include investigations and demonstrations of fishing methods, craft and fishing gear; the introduction of new fishing techniques; the promotion and sound development of the mechanization program; the training of fishermen for certificates of competency as masters and engineers; and the extension of oyster farming and the new important pearl oyster culture industry.

Problems such as over fishing and the conservation of fisheries resources receive attention and the Department also participates in the activities of the Indo-Pacific Fisheries Council. Two modified junk type mechanized vessels are operated at general purpose demonstration vessels and a small steel trawler, the ALISTER HARDY, is available for offshore extension activities.

The Fisheries Development Loan Fund, a fund of HK $2 million provided specifically for the development of the Colony's middle and distant waters fleet, is administered by the Department; also a Colonial Development and Welfare Scheme which provides mechanization loans for fishermen. Close liaison is maintained with the Fish Marketing Organization which administers two other fisheries loan funds and investigates all applications for loans from these funds which provide a capital of over HK $4.5 millions for the development of the industry.

The fisheries Research Station occupies a position in Hong Kong comparable with other national and regional institutes studying fisheries resources elsewhere. Its activities are centered on a biological and oceanographical investigation of the continental shelf within a radius of approximately 800 km. of the Colony extending from Formosa to the Gulf of Tongkin, for which purpose the

Station operates the research trawler CAPE ST. MARY of some 240 tons, a gift from U.K. Other activities include research into the culture of Chinese carps and other pond fish and studies of both edible and pearl oysters.

General: Marine fish is the principal primary product of Hong Kong and the Colony's fishing fleet is the largest of any port in the Colonies. Over 10,400 fishing junks of various sizes and designs and fourteen Japanese type-trawlers, ten of which are British registered, operate from the Colony. They are manned by a sea-going population numbering some 86,000, chiefly Tanka people, and the main fishing centres are Aberdeen and Shau Kei Wan, on Hong Kong Island, and Tai Po, Castle Peak, Sai Kung, Tai O and Cheung Chau in the New Territories.

Junks are built locally from imported timber, China fir being the most popular material, but in recent years continued shortages of fir have led to the increased use of teak and yacal, About 95% of the fleet is owner operated, the rest being directed by fish dealers and fishing companies.

Purse seiners, gill netters, shrimp trawlers and other inshore vessels operate mainly to the south of the Colony within the twenty fathom line. The bigger junk type trawlers and long liners have gradually extended their operations and now work mainly in 54.8 to 128 m. depths along the coast of Kwangtung. Many of these deep-sea vessels still depend on sail and, during the typhoon season, from July to October, their activities are severely curtailed.

There was a substantial increase in the mechanized fleet during the year; 669 additional vessels, the majority conversions from sail, joining the fleet, which now totals 3,329. The total quantity of fish and sea food products marketed was 47,229 tons valued at HK $53,994,468, as compared with 49,893 tons in 1959.

Oyster farming and pearl oyster culture. Edible oysters have been cultivated in the waters of the Colony for some 700 years. The principal cultivation area is Deep Bay where, from 2,452 hectares along the New Territories shores of the Bay, a total of some 600 tons of fresh oyster meat, valued at approximately HK $1,414,000 was produced in 1960. The bulk of this was processed into dried meat and into oyster juice and exported to oversea markets. Production this year, however, fell well below the level of previous years due to the severe damage wrought by typhoon Mary in June.

Six commercial pearling companies are now operating in the Colony on sites surveyed and licensed by the Co-operative Development and Fisheries Department. It is still too early to judge the success of their activities, but interim investigations have proved encouraging and there is increasing interest in this young industry. Four of the sites are in the Tolo Harbour and Channel area and the remaining two sites are in Port Shelter. A shortage of suitable sites threatens to restrict expansion.

INDIA

Fisheries Training Institute

The Governing Council of the United Nations Special Fund recently approved a program of 30 new projects and included among them was one of interest to fishery interests. On the recommendations of a committee appointed to assess and review the training of fisheries officers, the Government of India has decided to establish a Fisheries Training

Institute to train district fisheries officers for the Central and State Governments and managers for the fishing industry as well as training instructors. There will thus be provided trained leaders in the techniques for developing and exploiting inland and marine fisheries. Such training could also be offered to applicants in other countries in southeast Asia. The Institute will be equipped with laboratories, a library and workshops, a fisheries training vessel, and an auxiliary boat, machinery and gear. The Special Fund allocation is $610,300 and the Indian Government's counterpart contribution is the equivalent of $730,000. The duration of the project is three years and the executing agency is the FAO. The Special Fund will assist the Government of India in providing the services of experts, equipment, and fishing gear. The India Government contribution will provide counterpart personnel, buildings, fishing craft, and the payment of overhead costs.

Third Five-Year Plan for Fisheries Expansion.

Landings of fishery products in India, estimated at 1.0 million metric tons at the end of the First Plan, is expected to increase to 1.4 million tons by 1960/61 and to 1.8 million tons by 1965/66, according to the Third Plan Draft Outline. Nearly two-thirds of the increased production during the Third Plan is expected from marine fisheries. The mechanization of fishing craft and development of designs for fishing craft suitable for different sections of the coast were taken up in the First Plan. By the end of First Plan, about 650 boats had been mechanized, mostly in Bombay. Another 850 boats have been mechanized since the beginning of the Second Plan in Bombay, Kerala, Mysore Madras, Andra Pradesh, and Orissa. Training in the use and maintenance of machanized boats is being provided at 9 centers in different states. During the Third Plan, the program of mechanization of fishing craft will be expanded to effect mechanization of about 4,000 boats. Special emphasis is to be given to the exploration of new fishing grounds and to the exploitation of marine resources through cooperatives as well as through private fishing companies. Development of fishing harbors and berthing facilities will also be taken up. The provision of refrigerated rail cars and insulated trucks for the transport of fish over long distances has been included in the program. As regards inland fisheries, about 121,000 hectares of inland waters have been surveyed, about 5,300 hectares have been reclaimed, and over 242,000 hectares have been stocked through 1958/59. A training course in inland fisheries and management has also been organized. The program for the Third Plan will include survey of about 121 hectares, reclamation of 2,600 hectares and stocking of another 81,000 hectares.

Status of Fishing Industry

Fisheries development programmes in India have been considerably expanded during the last two years. Though fish production in 1959 was affected to some extent by the scarcity of oil sardine and mackerel, these two fisheries are occuring in large quantities this season and it is expected that the target of production of 1.4 million tons proposed to be achieved by the end of the Second Five Year Plan period would be reached.

Inland Fisheries: About 570,000 hectares of inland waters have been stocked with about 1,800 million of fry and fingerlings. The estimated production of inland fish was about 275,000 tons.

The State Fisheries Departments have given high priority in the production of quality fish fry for stocking ponds, tanks and reservoirs. Additional centres of fish-seed production were also established. Special emphasis has been given to the production of fish fry by induced breeding methods by pituitary hormones injections. Experimental breeding of common carps has also led to increased use of this variety for stocking inland waters.

With the increasing activity in the development of river valley projects, special emphasis has also been laid on the necessity for stocking these waters, proper management and effective exploitation. The recommendation made earlier by the Council regarding the river basin development has been adopted by the States of Orissa, Bombay, Kerala, Bihar, Madras, Punjab and the Control Boards of Tungbhadra, Hirakud, Koyna and Nagarjunasagar. Improved methods of fishing are being developed in the reservoirs of some of the States with the assistance of an FAO expert obtained from Russia.

The Central Inland Fisheries Research Station continues its studies on population dynamics, soil composition in fish ponds, introduction of new varieties of fish, weed control, water pollution studies and the Hilsa fisheries. Based on the investigations conducted at this Station, it has been considered that *Tilapia* is not a desirable fish for extensive culture in India. But studies on common carp and grass carp have yielded promising results. A survey of the fisheries of the larger reservoirs and lakes has been initiated on a systematic basis with the help of a FAO expert. His services have also been utilized for training candidates from the State Governments and Extension Units in the proper use of improved types of fishing gear in deep freshwaters.

At present there are ten Fisheries Extension Units functioning in various States. The programme has been reorientated, laying greater emphasis on the training of Village Level Workers and field staff of State Departments and in Community Development and National Extension Blocks.

Marine Fisheries: The programme of mechanization of fishing craft has been intensified by developing new designs of fishing craft in most of the coastal areas. At present there are over 1,600 mechanized fishing vessels in the county. With the increasing demand for the raw material supplies to the processing factories, these factories themselves are new taking measures to construct suitable mechanized fishing boats. Marine Diesel engines are supplied to fishermen at subsidised rates. Facilities have been extended for the import of engines for the benefits of the fishing industry, especially to cooperatives and groups of fishermen.

The Fisheries Enquiry Committee set up by the Government of India for enquiring into, reviewing and assessing the difficulties of fishing industry in relation to the existing rules and regulations applicable to motorised fishing vessels, studied the various aspects and made certain recommendations for improvement of mechanized fishing craft and also for providing adequate facilities for this programme.

Use of winches, gurdies and line haulers is becoming popular with the fishermen, in view of the benefits of operating a large number of units of gear. The Government have set apart some funds for the import of fishing equipment like synthetic twine, hemp twine, hooks, etc.

With the assistance of FAO experts, a survey was conducted in some of the States with a view to develop fishing harbors in important centres. Some of the surveys relating to the centres in Gujarat, Maharashtra, Mysore, Kerala and Madras have been completed. Port work has already been taken up in some of these centres.

The four Government of India offshore fishing stations continue their surveys for charting fishing grounds and, introducing improved methods of fishing gear. Useful information has been obtained with regard to potentially rich fishing grounds off the coasts of Gujerat, Mysore, Kerala, Madras, Andhra Pradesh and Orissa. These investigations will be continued. Private industry has already been atrracted to organize fishing companies and fish processing factories on commercial lines.

The Central Fisheries Technological Research Station is engaged in investigations in developing new designs of fishing craft, improved types of fishing gear, use of new materials, preservation of fishing materials and on beach boat trials. Two FAO Experts are assisting the Station in the organisation of research programmes. The investigations on the beach-boat trials are of particular interest to some of the under-developed countries in the region. This report deals with hull-shape and construction, handling of the boats in the sea and on the beach, engine type, engine power, engine installation, propellers, shafts and pumps.

The Central Marine Fisheries Research Station continues its studies on the commercially important fishes. Work relating to the data collected by the offshore fishing vessels and on population dynamics received special attention.

Fishery Technology: With the increasing landings of fish and the need for proper utilisation, the State Governments are establishing additional ice and cold storage plants and are promoting improved methods of fish curing, transportation and marketing. Fishing companies are also engaged in freezing and canning of some of the important varieties of fishes, both for internal and external markets.

The Central Fisheries Technological Research Station has taken up problem relating to improved methods of curing, freezing and canning and also investigation relating to improvement in the quality of the product.

Marketing: Fish marketing though developed to some extent in the coastal areas and within limited regions, there is definitely a need for proper development of marketing in the inland States and hinterland. Three FAO Fish Marketing specialists undertook surveys in certain regions and made certain recommendations regarding the development of fish trade. It is necessary to conduct marketing surveys, study local marketing programmes, initiate integrated schemes for survey and introduce pilot marketing schemes for establishing regular trade channels.

In order to enable the fishermen—the primary producer, to get better returns, adequate attention is being paid to the development of producers' cooperative societies and marketing federations. The possibility of introducing regulated markets is also being examined. The Ministry of Food and Agriculture have recently arranged to operate six refrigerated rail vans in three routes.

Training: The Government of India are establishing a higher training institute for Fisheries Officers at district levels, with the assistance of U.N. Special Development Fund. The existing course

on inland fisheries continues to give training to candidates sponsored by the State Governments and by some of the neighbouring countries.

Training to candidates for Skippers and Mates tickets is being given on the fishing vessels belonging to the Off-shore Fishing Stations. In addition to the two six months' courses in fishing boat designs and construction, an advanced course of three months was conducted in fishing craft designs; these candidates are now employed in the maritime states. The Central Fisheries Technological Station is now providing a training course for carpenters for understanding the designs and follow the lines of construction. Training was also given to nominees from states in the designs, fabrication and operation of shrimp trawls from small powerboats.

Foreign Assistance: The Central and State Governments continue to take advantage of the offer of technical and commodity assistance from FAO, Colombo Plan, Indo-Norwegian Project and TCM with regard to power fishing, improved methods of fishing gear, development of fishing harbour, storage, marketing and transportation, fishery surveys, organisation of fishery technological researches and training of personnel required for management of fisheries.

The Government of India, considering the importance of fisheries, have considerably increased the financial provision for fisheries schemes in the Third Five Year Plan.

INDONESIA

According to the Fisheries Department of the Indonesian Province of North Sumatra (which is comprised of East Sumatra and Tapanuli), landings of fishery products in that area in 1959 totaled 28,258 tons, valued at Rp. 225.4 million (about US $7.1 million), as compared to 24,177 tons in 1958. The comparatively favorable weather conditions during 1959 were given as one reason for the larger catch. During 1959, 40,456 fishermen (including 9,699 part-time fishermen) were engaged in the fishing industries in North Sumatra, of whom four-fifths were in East Sumatra alone. A total of 8,931 fishing vessels were used in North Sumatra of which 355 were motorized. There are a total of 425 of fishing enterprises operating in East Sumatra and 202 fishing enterprises in Tapanuli. For the past years plans have been made for the modernization of the fisheries of North Sumatra by using trawlers and long-lines. (*Comm. Fish. Rev.*, Sept. 1960).

JAPAN

Oyster-Freezing Plant

In June 1960, large Japanese fishing company completed the first plant in Japan designed for production of fresh-frozen oysters for export. The Hiroshima plant was planned and equipped under a technical agreement with a U.S. firm. Thus it will be possible for the first time to export to the U.S. raw Hiroshima oysters, which up to now have been sold mostly in the Japanese market. In addition to the frozen raw oysters, the Hiroshima plant will develop into a general food processing factory with canning and

sausage-making departments.

The three main points about the freezing installations that have resulted from the technical partnership with the U.S. company are:

(1) Freon is used as a refrigerant in industrial quick-freezing for the first time. Generally in Japan for large-scale quick-freezing, ammonia is used as the refrigerating agent.

(2) By using unit coolers, the air-blast system is employed throughout for freezing and cold storage. Temperatures in the freezing rooms can be brought as low as -30°F. (-34.8°C) and the oysters are frozen while still loaded on special transporting buggies. The unit coolers and all the other latest types of machinery, such as water coolers, the air conditioning, and the all-automatic ice machine, can be controlled and operated from a central control panel.

(3) Shucking of the oysters is done on a new type of installation. For the first time in Japan oysters will be shucked with knives on installations called "bunkers". The shucking tables and the floors are all of terrazzo, and the concrete that is used is of a type that will not crack and produce crevices in which germs can grow. Containers for the oysters are of stainless steel, washing is done with chlorinated water, and sterilization is complete, so that every effort has been expended on hygienic details.

The main parts of the plants are the oyster-processing plant, the refrigeration plant, the cannery, the ice plant, the boiler room, the sanitation control room, and the offices. The total area is about 7,950 m^2. The plant is able to (1) freeze 36 tons a day of oysters or shrimp, (2) store 600 tons of frozen products, (3) make 20 tons of ice a day, (4) can 2,000 cases per day, and (5) make 20,000 sausages a day. (*Comm. Fish. Rev.*, Sept. 1960).

KOREA

The Central Fisheries Experiment Station, Pusan, is carrying out research in marine and fresh water fish and shellfish culture. The projects underway are as follows:

Marine Aquiculture Programs:

(1) *Tidal Flats Development Survey*

Most of the West and South coast line of this country is bordered by wide sandy or muddy tidal flat areas. Between the high and low tide marks. There is approximately 1,182 million pyong or 965,000 acres of flat land. The great part of this land is unproductive because of constant changes of the bottom configuration by tidal currents, and the resulting high turbidity. However, for increasing nations protein food supply, it must be developed into culturable lands. This will also help to increase the income of the inshore fishermen. The surveys on this project are designed to determine the proper species to culture on the proper bottom by determination of soil particle composition, determination of bottom exposure to air, amounts of seston and plankton. A specific program on the ecology of the *Tapes* clam is progress. This species has a wide optimal living range in various adverse conditions. Beginning this year a pilot field experiment is being operated to find out growth rates, conditioning factors and gonad maturity in a certain area. The survey program in the future will classify the

tidal flats by their ecological factors, and a transplantation experiments on different shellfish, larver, and oyster.

(2) *Oyster Spat Collection Experiment*

The Oyster culture methods in this country have been limited to the Tree Branch or Stone methods in tidal flats. Topographically the South archipelago bay area is suitable for the raft method of oyster culture. The purpose of this project is to develop Raft-method culture by which a better quality of oyster produced and also the growth rate is almost doubled in the same periods of time when compared to former methods. This project is being carried on in Chindong Bay, near Masan.

The main research items on this project is as follows:

a. Daily meterological and oceanographical observation in the Bay,
b. Analysis of oyster spat settling data on various types of collectors, layers and time.
c. Fluctuations of oyster larvae and plankton collection.
d. Hanging of spat under rafts and growth rate and conditioning factor determination.

(3) *Preliminary Abalone Pearl Culture Experiment*

Due to lower water temperature, the pearl oyster (*Pinctada martensii* Dunker) does not extend its distribution to korean coastal waters. However, high quality natural pearl can be produced from abalone. This project has been started to determine the feasility of producing good quality pearl formation by artificial techniques. Its principal objective is to find out a technique to produce spherical pearl from this single shelled animal without loosing the artificial nucleus inserted into the body.

Another objective of this project is to develop a technique of reducing abalone mortality during the stocking period in summar time. The high mortality occures from the injury to the animal during collections. The mortality is greatly codtrolled by using antibiotics treatments.

(4) *Propagation Program of Salmon and Mullet*

Small stocks of chum salmon migrate up the East coast rivers during their spawning season. These stocks have shown a decrease during the past years. To conserve these resources a program of artificial propagation has been started. The fish culture of salmon has been practised since 1958, and in the season of 1959-60, about 110,000 young salmon were hatched and planted in the Yong-Dok, Oh-sip Chon River.

An experimental propagation program on a species of mullet which spawn in Yeungsan River Estuary is in progress, the Mokpo Branch Station reports that they distributed 200,000 fry to salt farms during the last season. More basic biological research concerning the life history and development of these species is needed before a successful propagation program can be developed.

(5) *Publication of Illustrated Pamphlets on Commercially and Potentially Important Animals and Plants*

It is often difficult for students and fishery workers to identify the important species of marine and freshwater organisms. This situation has also often caused much confusion in the collection of accurate fisheries statistics where misidentification of species have been made.

To aid in solving this problem, following two manuscripts have been

completed in a series of 12 coverings the identification of different groups of animals or plants:

a. Illustrated Guide of Common Shellfish of Korea.

b. Identification of Inshore Phytoplankton.

Freshwater Aquiculture Programs:

(1) Repair and Rehabilitation Program of Chungpyung and Chinhae Hatchery

The Chungpyung Carp Hatchery has been completely repaired and approximately one fourth of the Chinhae installation have been rehabilitated at a cost of 79,000,000 H. by USOM technical assistance and aid.

Additional planning is being carried out to complete the rehabilitation of the Chinhae hatchery during the next year.

The two stations have been redesigned to include the latest construction and culture methods used in other parts of the world.

(2) Introduction of Modern Fishculture Methods and Techniques

Aquiculture section is very fortunate having had three ICA participants in fish culture who have been sent to United States for training in the latest methods and techniques. Upon their return home, these men have assumed positions of responsibility in the hatcheries and there they are introducing modern methods and techniques suitable for conditions in this country.

(3) Freshwater Fisheries Extension Program

The planning of the fisheries extension program to be carried on through the Agricultural Extension Service is now underway. Emphasis will be given to the culture of carp and loach in rice paddies. In addition to this, considerable attention will be paid to the development of farm ponds for the culture of carp. Instruction booklets on carp culture for the farmer in rice paddy and on other fish culture are being prepared.

(4) Fingerling and Egg Production and Distribution Program

The distribution of carp eggs and fingerlings had been carried out annually from the two hatcheries since 1929.

New method of distributing fingerling in sealed plastic bags with oxygen and water has been very successfully intorduced during the last season.

Another innovation greatly appreciated by the fish farmers is the delivery of the fingerling to the pond or farm side by the hatchery personnel. This insures much better care of the young fish and a greatly reduced loss.

The following table show the total carp egg and fingerling distribution for the past 5 years.

Distribution Record

(*Include planting in Rivers*)

	1956	1957	1958	1959	1960
Carp Eggs	4,750,000	6,650,000	16,525,000	18,100,000	28,400,000
Carp fingerlings	180,000	130,000	325,000	229,500	606,300

(5) *Fishculturists Training Program*

Annually classes in the culture of carp and other pond fishes are held at the Chinhae Fish Hatchery. The purpose of this instruction is to increase the number of trained fish culturist through out Korea. This year three Sessions were given in which 82 people received the training. The students are composed of professional fish farmers, Agricultural Extension Service workers, some vocational education teachers, etc.

Biological Museum:

Collection of marine and freshwater fish, invertebrates, and algae of Korean waters are maintained, and are being continually enlarged to meet the needs of research workers.

About 460 species of fish and 150 species of shellfish have been catalogued.

FEDERATION OF MALAYA

The Quarterly Progress Report for the 4th quarter 1960 of the Fisheries Department gives the following information:

Landings in the fourth quarter of 1960 showed a slight increase over production in the last quarter of 1959.

Mechanisation

Rate of Mechanisation

	4th Quarter 1960	3rd Quarter 1960	x 4th Quarter 1959
Inboards	139	258	112
Outboards	123	207	116

x Excluding Johore figures

At the end of 1959 there were 3,123 inboard-powered and 4,761 outboard-powered boats in the country. In 1960 a total of 886 inboard-powered and 708 outboard-powered boats were *newly registered* thus making a total of 4,009 inboard-powered craft and 5,469 outboard-powered craft at the end of 1960.

Developments in Gear Technology

Over most of the country there were signs of a growing preference for synthetic fiber nets over those made of ramie. In North Selangor a new type of purse-seine, readily convertible into a drift-net of the Jaring Tenggiri type, has been successfully operated for catching bawal itam. The net costing M. $1,200 can be operated by a team of seven men operating from two boats. In the North East, the six units of synthetic pukat jeroot bilis which made their appearance at the end of the last quarter were fairly successful, but the synthetic pukat dalam did not do as well owing to the scarcity of ikan kembong.

Co-operatives

At the end of the fourth quarter, there were forty-eight Fishermen Co-operative Credit and Marketing Societies with a membership of 3,588 registered under the East Coast Fisheries Aid Scheme.

Commodities handled by the East Coast Marketing and Transport union for sale to member societies at preferential rates were :—

Diesoline	13,950	gallons
Petrol	24	„
Ice	3,761	blocks
Salt	1,608	piculs
Life Jackets	26	pairs
Wire-netting	142	rolls
Rattan	5,375	pieces
"Kulit Samak"	17	piculs
Gunny Sacks	4,750	pieces
Firewood	2,200	pieces

The Union also received M. $22,454.00 worth of synthetic drift nets from the Apex Bank for distribution to selected societies which were undertaking collective marketing of their members' fish. In the North West, the Kuala Sanglang Co-operative Society is attempting collective marketing of the members' produce. A landing platform has been erected and a sorting shed and an ice-box provided for collecting the catch.

Fisheries School

The new Marine Fisheries School at Glugor was formerly declared upon by His Excellency the Governor of Penang, on the 18th of November. Among those present were the Minister of Agriculture and Co-operatives, the Director-General of FAO and Director of the FAO Fisheries Division, Dr. D.B. Finn. Trainees have already moved into the new hostel and lectures and demonstrations are now held in the modern and well-equipped lecture rooms and workshops housed in the new administrative block. The results of the end of course examination were :–

1. Engine Care and Maintenance 17 sat 16 passed

2. Engine Driver's Third Class 13 sat 12 passed

3. Helmsmanship of a Fishing Boat 14 sat 11 passed

Of the 17 trainees, 10 were from the East Coast.

As the school at Sebrang Takir in Kuala Trengganu is to be shortly opened for training of fishermen from the East Coast, additional instructors in Helmsmanship, Navigation and Engine Maintenance were recruited and attached temporarily to the School at Glugor.

Freshwater Fisheries

The following number of fish dry were distributed during the quarter to various areas in the Federation :

	4th Quarter 1960	3rd Quarter 1960	2nd Quarter 1960
Lampam Jawa	29,037	57,983	45,420
Lee Koh	19,996	13,575	7,145
Kalui	70	10	14
Tilapia	20,746	22,155	3,400
Sepat Siam	–	5,037	–
Indian Carp	31,101	–	–
Total	100,950	98,760	55,979

77,000 Indian carp fry of 1.3 cm. size were imported from India by air and kept at the Fry Breeding Station at Tapah. About 38,000 fry were eventually available for distribution to fish farmers at 10 M. cents each.

A total of 124 ponds covering 31.56 hectares were opened up for fish cultivation in the fourth quarter of 1960, thus bringing up the area of fish ponds in the country to 517.6 hectares. In addition 28 mining pools covering 9.7 hectares were cleared of predatory fishes and 18 pools covering 24.3 hectares were stocked with fry. Stocking of mining pools and other natural waters is now an important activity of the Department undertaken primarily to provide a cheap source of food to the general public.

Research

Cockles – Investigations into various aspects of cockle-culture were completed in the quarter and a report will be prepared when the data is analysed. Collection of cockle-seeds was delayed by storms which occurred during the period of spatfall. Seed were scarce but of good quality with a 18 l. kerosene tin fetching as much as $20.00. A new bed was discovered in Tanjong Tokong in Penang but spatfall was limited.

Rastrelliger Fisheries – Routine investigations into gonad development, food, plankton productivity and salinity were continued and a report based on these observations was prepared for the 9th Session of the Indo-Pacific Fisheries Council meeting, at Karachi.

New Technological Laboratory

The new Technological Laboratory at Glugor was completed in this Quarter and some of the research work is now being carried out there.

Food Technology

The preliminary study on salt fish preservation was completed in the quarter and a paper on this was submitted to the Indo-Pacific Fisheries Council meeting at Karachi.

Salinity Observations off Langkawi and Kedah

Attempts to get fishermen collect water samples off the Kedah and Langkawi coast were not successful and arrangements are now being made with the Marine Department to get fresh samples.

Technical Committee Report for the IPFC

Reports concerning activities of Panel A and B of the Technical Committee for the period between the 8th and 9th Sessions of the IPFC were submitted for the current session of the IPFC at Karachi. The following papers were also submitted :–

1. Study of Drift from Salinity Determinations in the North Malacca Straits.
2. A Preliminary Study on the Preservation of Salt Fish in Cold Rooms.

Research, Fresh-water

Work on the Udang Galah was continued in the quarter under review. Attempts were mostly directed at rearing larvae in the laboratory. One batch of larvae fed with shrimp eggs has now survived for as long as 55 days.

A total of 26 farmer trainees attended a fish-culture course at Penang.

General

A Seminar on Fishery Development Planning was held at Glugor on the 18th and 19th November. It was opened by the Minister of Agriculture and Co-operatives. Among those participating were Dr. D.B. Finn, Mr. C. Beever and Dr. G.N. S. Rao of FAO and also representatives from the Ministry of Rural Development, Treasury, Ministry of Commerce

and Industry, the Department of Co-operative Development and the Fish Culture Institute at Malacca. Papers on various aspects of Fisheries Development were read and discussed at the two-day meeting.

The five year plan for fishery development include the following:

Oyster Culture: Although edible oyster occur in many places in Malaya and the conditions are suitable for their growth this source of excellent food and possible basis for a profitable export trade has never been investigated. It is proposed that an expert in oyster culture be brought to Malaya under the Colombo Plan and to carry out investigations to determine the possibilities of establishing an oyster culture industry in Malaya. This expert would be aided by Fisheries staff whom he would train in his methods and give a thorough grounding on the techniques of oyster culture.

Regional Fry Breeding and Distribution Stations : The Development Plan of the Ministry of Agriculture for the years 1956-1960 envisaged the completion of five fry breeding and distributing stations various parts of the Federation. Of these five only *one* station will be completed by the end of 1960 at Kuala Kangsar, Perak. The extension of the Fresh-water Fisheries services of the Fisheries Department has been so rapid and demands for advice and fry so heavy that it is essential that the additional four stations should be completed within the period of the next five-year development plan. It is proposed that one station be built in 1961, one in 1962, one in 1963 and one in 1964. The stations will be built in (i) Kedah (ii) Negri Sembilan (iii) Central Pahang and (iv) Kelantan, in which areas there is the greatest need for the stations and from where a complete coverage can be given to the whole of the Federation for supply of fry and advisory services.

Aquarium for Freshwater and Marine Research: Laboratory research into the conditions governing growth and reproduction of freshwater and marine fishes, shellfish and prawns is being greatly restricted by the lack of a suitable aquarium in which the living organism can be studied under controlled conditions. The need for an aquarium will increase in the near future as the rapid growth of fish and cockle culture brings to light new problems and the present research opens up new channels for investigation. The results of these investigations are very directly applicable to the practice of fish-farming etc. in rural areas and, indeed, are aimed at providing the rural peoples with the best material with which to work and the best techniques to apply to their pond culture, etc. A new aquarium building fitted with aquarium tanks, storage tanks and a pumproon is required.

Fisheries Office in Perak & Johore: Government approval has been obtained for creation of two new posts of Fisheries Officers in the Fisheries Department. These officers are required for Lumut, Perak (in order to divide the present over-large North West Region into two more manageable areas, Kedah, Perlis, Penang, and Province Wellesley in the North and Perak in the South) and for Johore Bahru, Johore (where it has long been intended to transfer the responsibility for Fisheries Administration from the Marine Department to the Fisheries Department). Offices, launches, etc. are required for the stations in Perak and Johore where no zonal offices exist at present.

Cameron Highland Fry Breeding Station: The rapid development of the Cameron

Highlands Hydro-Electric Scheme and the relaxation of emergency measures in the Cameron Highlands area provide an opportunity to establish a very valuable new source of food fish particularly for the people living in the area. The conditions in the area are unique in Malaya and it is proposed that possibilities for freshwater fisheries development should be fully exploited to the benefit of the rural population and of the Cameron Highlands as a tourist attraction.

It is proposed that a fish hatchery should be established close to the Hydro-Electric Scheme at Ringlet. This hatchery would enable fish fry of selected species to be bred for stocking in the impounded waters and the streams. Two types of fish would be used:

(i) Local food fishes which the rural population can rear in their own ponds and which will also be an attraction for anglers visiting the Cameron Highland;

(ii) Trout which will be hatched and stocked in the streams and lakes for anglers.

The provision of these amenities will add greatly to the attractiveness of the Cameron Highlands and will provide a considerable source of income from fishing licences.

PAKISTAN

Fish Meal and Oil Industry:

Pakistan's fish-meal industry is passing through an indeterminate stage due to the rapid decline in world prices and a lack of suitable stocks of fresh and dried fish. Fish-meal production in 1959 was estimated at 3,000 long tons. Fish oil is produced on a very small scale by cottage industries; production figures are not available. No fish oil was exported from Pakistan in 1959. Pakistan's fish-meal industry consists of approximately six commercial plants concentrated on the outskirts of Karachi. Of these, only two are modern reduction plants; the others employ the grinding process with sun-dried fish as the raw material. Total estimated capacity is approximately 130 tons of raw material per day. The Government of Pakistan plans to approve the establishment of a fish-meal plant in East Pakistan and a large plant in West Pakistan at Gwadur. The West Pakistan Plant will have a 74-ton-per day reduction capacity and will also have fish-oil extraction facilities; it is expected that the plant will be in operation by April 1961. It is estimated that the cost of production of fish meal in Pakistan is between Rs. 430 and Rs. 480 (US$91 to $102) per long ton for those factories which have their own fishing trawlers. Sardines used for reduction purposes cost from Rs. 120 to Rs. 140 (US$25 to $30) per ton, while fish heads, fish waste, and sharks cost Rs. 60 (US$13) per ton. Fresh fish used in the two modern fish-meal plants is not available on a continuing basis. Present fish-meal prices of approximately US$79 a long ton, cost and freight Continental port, bring in no buyers, but prices lower than US$70 bring in some buyers, mainly from Germany, Holland, and Ceylon in 1959, Pakistan's highest export price to West Germany was US$132 a ton.

There are no Government aids or special taxes for the benefit of Pakistan's fish-meal and oil industry. But under the Export Bonus Scheme which came into operation in January 1959, Pakistan's exporter of certain commodities, including fish-meal, can utilize

a stated percentage of their foreign exchange earnings for the importation of some 219 commodities. Exporters of fish-meal and oil are entitled to bonus vouchers up to 20 percent of the foreign exchange earnings. The Government of Pakistan has recently informed fish-meal exporters that the bonus entitlement has been raised from 20 to 40 percent. These bonus vouchers can be sold openly and at present are worth a premium of Rs. 120 (US$ 25) for the face value of Rs. 100 US$ 21). The Prospect of earning this premium enables the Pakistani exporter to reduce his export prices.

Peru's entry into the export market for fish-meal (67 percent versus 47 percent for Pakistan) and an average export price of US$79 per metric ton, has adversely affected Pakistan's export trade. The demand for Pakistan's fish-meal is now very low. This, in turn, has resulted in lower production, now reported to be about 5-7 tons per day. One plant owner has sold out because the fish-meal business is now non-profitable.

PHILIPPINES

Quarterly Report of the Bureau of Fisheries gives the following information: Intensification of fish stocking in inland bodies of water, adoption and implementation of an expanded fisheries research program and the popularization of commercial as well as community canning of fish are among the accomplishment of the Bureau of Fisheries during the first quarter of the current fiscal year 1960-1961 (July - September).

Fishpond operators through the help of fishery demonstrators, have increased their yield per hectare with the use of effective methods of fish culture and the adoption of fishpond fertilization and supplementary feeding.

For the first three months of the fiscal year 1960-1961, the Bureau of Fisheries has issued permits for 63 new fishponds and approved the renewal of 182 others. The aggregate area of these fishponds is 2,167 hectares compared to 1,013 hectares for a corresponding period last fiscal year.

Through the initiative of the fisheries office, modern methods of deep-sea fishing have been introduced.

Demonstration of deep-sea fishing methods which was stopped for lack of facilities, in the previous years, have been resumed following the acquisition of m/v MALASUGUI, a reparations vessel from Japan, equipped with modern electronic devices.

During the period under review, the m/v MALASUGUI undertook extensive survey of potential fishing grounds. The potentialities of these fishing grounds as determined by these surveys serve as incentives to enterprising fishermen.

Limnology Laboratory

Dr. J.S. Dendy, FAO Technical Assistance Officer, and Dr. F.W. Morawa, Limnologist from Germany and assistant to Dr. Dendy, terminated their tenure of assignment with the Bureau of Fisheries on July 16 and August 21, 1960, respectively. The Project was left to Mr. P.A. Acosta, Fishery Technologist of the Bureau of Fisheries and main counterpart of Dr. Dendy. Dr. Morawa pursued fish census work for the Limnological Project in Laguna de Bay, the main fresh water lake close to Manila. The Limnological Research Project will be without

FAO Technical Assistance Officer until the end of this year. A new Technical Assistance Officer is expected to be assigned by FAO to the Philippines in the very early part of 1961 to continue until 1962 as programmed in the request of the Government.

The new building to house the laboratories of the Limnological Research Station of the Bureau of Fisheries is now under construction in the southwest shore of Laguna de Bay Lake in the town of Los Banos, Laguna Province. This new station is 62 kilometers from Manila.

Fish Farming

The Central Luzon demonstration fish farm of the Bureau of Fisheries located at Tanay, Rizal, has become a main distribution center for fish seedlings to stock natural inland waters and freshwater farm ponds in the island of Luzon. During the period from July 1959 to June 1960, this fish farm has distributed some 160,000 fish seedlings of various kinds. These include several selected varieties of carp, giant gourami, plasalit, kissing gourami, and *Puntius* species all of which are selected species introduced mainly from Indonesia. Native species such as *dalag* (*Ophicephalus striatus*), *hito* (*Clarias batrachus*) and acclimatized *bangos* (*Chanos-chanos*) have also been distributed from the station.

The availability of these fish seedlings is an important factor for the stimulation and promotion of fish production in fresh water areas in the country.

Accelerated activities for the production of more fish seedlings is being pushed through in the station to cope with the increased demand of private enterprise, inspite of limited facilities at the disposal of this station.

Fertilizers and Fish Ponds

The practice of applying fertilizers in fishponds as in agricultural lands has proven to be practical as a means of improving pond conditions and ultimately the fish production in fishponds in the Visayan region.

This has been found to be especially true in Occidental Negros, Panay Island, Cebu and Bohol, according to the supervising fishery technologist of the Bureau of Fisheries, who recently inspected the areas.

It is satisfying to note that while heretofore bangos fishponds depended on their basic fertility, coupled with management experience for their production, today the practice of renewing the nutrients for the ponds that are being constantly exhausted has gained acceptance and is becoming standard practice in fishpond management.

Successful field tests undertaken by the fish farm manager at the Visayan demonstration fish farm, Molo, Iloilo City, with the use of complete nitrogen-phosphorous-potassium (N-P-K) fertilizers as well as nitrogen-phosphorus (N-P) fertilizers have led the way.

Encouraged by their experience with agricultural crops, the fishpond operators in the area are very receptive to the fertilization practice.

There is a great deal more of basic information that need to be known to undertake fishpond fertilization in the most effective and economical manner, it was pointed out. For this purpose, experiments in pond fertilization are continually undertaken by the Bureau of Fisheries farm pond stations but progress has been rather limited due to inadequate supplies, facilities and personnel.

Personnel

Mrs. Priscilla C. Borja, Ichthyologist of the Bureau of Fisheries, returned from Europe last September 9 after a six-month FAO fellowship in marine biology in the United Kingdom, Germany and Rome. She underwent training on the theory and methods of fish population dynamics in the United Kingdom. She conferred at Hamburg, Germany, with Dr. Klaus Tiews, former FAO expert on Marine Fisheries Biology with the Division of Fisheries Research, Bureau of Fisheries and had some briefings on the different research activities which were initiated by the expert. Mrs. Borja spent two weeks at the FAO headquarters in Rome to make her final report before returning to the Philippines.

Prof. Dr. Andres von Brandt, Director of the Fishing Gear Research Institute of Germany, spent 8 days in Manila and neighboring towns to make studies and observations on the different methods of fishing. He was particularly interested in the operation of the *basnig*, the large lift net. For this purpose, he went out to make observations of the actual fishing operation with one outfit in Manila Bay. Dr. von Brandt before coming to Manila spent two months in Japan and a forthnight in Taiwan on the same mission.

U.S.A. (HAWAII)

The Honolulu-based fisheries research ship CHARLES H. GILBERT, of the U.S. Bureau of Commercial Fisheries, returned Saturday, 10 December 1960 to Kewalo Basin from a two-month cruise in South Pacific waters. This voyage, the GILBERT's fiftieth, took a party of scientists to Fanning and Christmas Islands in the Line group, to Tabiti and then to the atoll of Rangiroa in the Tuamotu Archipelago and to most of the major islands of the Marquesas. Bait fish were cought at many of these islands for fishing skipjack tuna (aku) to provide material for the scientists' studies. One of the major research objectives was to compare the blood types of the skipjack tuna taken in each of the areas visited in order to determine whether the fish around each of the major island groups of the central Pacific are interrelated or form separate local populations. The skipjack, which supports Hawaii's largest commercial fishery, is strongly seasonal in nature, indicating that the fish are migratory. Tuna experts believe that this species may exist in such great numbers in the ocean as a whole as to provide the basis for much greater commercial catch than is produced at present. In order to determine what these potantialities may be, and how bast to go about developing them, the necessary first step is to lears whether the skipjack of the central Pacific belong to only a few large, wide-ranging populations or whether they form a large number of separate stocks. The results of research working this voyage of the GILBERT indicate little relationship between the skipjack of Hawaiian waters and those found around the South Pacific archipelagoes. The blood studies further showed that the skipjack of Marquesan and Tuamotuan waters are of strongly differing types. Other scientific work done during the cruise by fishery biologists included the collection of the very small larval and juvenile stages of tuna by means of special trawl of the behavior of skipjack were made through the windows in the unique underwater observation chambers in the stern and bow of the

GILBERT. The reactions of the tuna to sounds produced by porpoise and squid were recorded and will be studied in comparison with similar behavior records taken in Hawaiian waters. Skipjack were found in good numbers in the Marquesas and Tuamotu areas, where they were fishes with good success. Schools also appeared numerous in Tahitian waters, but the skipjack there were moving fast and erratically and did not respond well to the fishermen's bait.

FAO ACTIVITIES

Staff Movements

Dr. J. Schärfe, FAO Gear Technologist visited India where he inspected the various ETAP Projects and equipment. He also attended the 9th Session of the IPFC and contributed to the technical discussions on fishing craft and gear.

Mr. W.A. Dill, Chief, FAO Inland Fisheries Section, visited Pakistan, India, Indonesia, Singapore, Malaya and Thailand and reviewed with the Government Officials current situation regarding the inland fisheries in these countries.

Technical Assistance

Mr. Bertil Johnson (Sweden), arrived in India during January as an FAO/ETAP Advisor to Government of India for developmnet of fish harbors.

Mr. Jai Yoon Hahm (Korea) has been awarded a FAO/ETAP fellowship for six months to undergo training in Norway and Iceland in the field of whaling. He will commence his studies at the Norwegian Institute for Whale Research, Oslo.

Mr. Sien Seng Wan, General Manager, Malayan Cooperative Wholesale Society Ltd., has been awarded a fellowship to study fisheries and agricultural marketing at Hong Kong for one month.

IPFC AFFAIRS

9th Session

Under the able guidance of its Chairman, Mr. Tran van Tri (Vietnam), the Indo-Pacific Fisheries Council had a most successful Session in Karachi, Pakistan, from the 6th to 23rd January 1961. Through the courtesy of the Government of Pakistan, facilities were made available which were eminently satisfactory. The Minister for Food and Agriculture, Lt. Gen. K.M. Sheikh delivered the inaugural address and welcomed the delegates of the 15 member countries to Karachi (Burma and Cambodia were unable to send representatives).

The Organizing Committee under the chairmanship of Dr. M.R. Qureshi, Director, Central Fisheries Department, provided excellent services and facilities for the Session. The Session was held in the New Fisheries Research Building at the Karachi Fish Harbor. Locally recruited clearical staff provided excellent services and contributed very greatly to the success of the Session. The main item of procedural business was the Amendment to the Council's Agreement and Rules of Procedure to bring it in line with the principles adopted by the FAO Conference. The Technical Committees had before them a large amount of data and reports on the various aspects of fisheries throughout the Region. The work during the inter-session period by the Committees

had resulted in a preparation of most comprehensive and detailed studies, particularly in the soci-economic, marketing and fisheries food technology fields.

Mr. A.M. Salimullah, Joint Secretary of the Ministry for Food and Agriculture of the Government of Pakistan kindly consented to attend the closing ceremony of the 9th Session and presented the closing speech.

Mr. D.T.E.A. de Fonseka (Ceylon) succeeded Mr. Tran Van Tri (Vietnam) as Chairman and Dr. M.R. Qureshi (Pakistan) was elected as the Vice-Chairman.

Symposium

The Symposium for the 9th Session which was entitled "How to formulate program of fisheries research and technological improvements, particularly in fish handling required for the implementation of national policies for fisheries development and methods of assessing progress in these programs" aroused considerable interest. Twentyfour valuable papers has been contributed from both within and without the Region and under the guidance of the Convener, Mr. D.J. Gates, Australia, there were most stimulating discussions and exchange of opinions, particularly in relation to the common principles upon which a fishery development program should be based.

In assessing progress in the development programs it was considered that an accurate judgment could be made in regard to the success of the exploratory fishing or gear research program where the impact on the industry is immediate. However the assessment of progress in biological research is more difficult and, in most cases, only after several years of patient work that biological and oceanographical research pay dividends.

10th Session Symposium

The Council decided that the Symposium for the 10th Session should be "The Development of Mechanized Fishing Fleets" and requested Mr. Lee Bong Nae (Korea) to act as Convener with the assistance of the specialised staff from the FAO Fisheries Division.

Recommendations

After reviewing the status of the fishing industry in the Region, the Council made a number of recommendations concerning fisheries research, documentation, technical assistance and training centers, as well as FAO Regional Staff. In the field of documentation, the Council was convinced that the preparation of the following documents as well as comprehensive reports on the following subjects would be a helpful guide to the Member Governments in their organization of research as well as in their schemes for improvement in fish production, handling, processing, distribution, marketing, and socio-economics of fishermen, and requested FAO to take necessary action to have these documents compiled and published at an early date.

Manual on Sampling Methods

Comprehensive List of Common of Scientific Names

Use of Fish for Aquatic Weed Control

Use of Anaesthetics and Tranquilizers in handling and Transport of Fish

Effects of Mechanization of Craft and Gear

Freezing and Cold Storage Costs

Fish Transport Containers

Fish Drying Processes

Fisheries Products Manual

Boiled Fish

Use of Seaweeds for Human Consumption

Information on Factors Impeding Fisheries Development

Organization and Administration of Fishery Credit Schemes

Manual of Fishery Statistics

The Council also requested FAO to strengthen its Asia and Far East Regional Office by the addition of two Fisheries Officers a craft and Gear Technician and a Economist-cum-Marketing Officer.

Training Centers and Seminars

The Council gave considerable thought to the establishment of seminars and training centres during the ensuing inter-session period and decided to request the FAO Fisheries Division to explore the possibilities for establishing a workshop on Rastrelliger and a Training Centre or Seminar in fishing craft and gear for fisheries officers.

Arising from the recommendations made at the 5th FAO Regional Conference held in Saigon, the Council also requested FAO to examine the possibility of establishing training centers or seminars on fisheries administration, fish marketing and fishery credit, if funds and facilities could be made available.

Time and Place of the 10th Session

Through the courtesy and generosity of the Government of Korea, the Council was able to accept an invitation from that Government to hold its 10th Session in Seoul during the final quarter of 1962, the precise date to be decided by consultation between the Government of Korea and the Executive Committee.

Personnel

The following office bearers of the Council were nominated during the 9th Session.

EXECUTIVE COMMITTEE

Chairman: Mr. D.T.E.A. de Fonseka (Ceylon)

Vice-Chairman: Dr. M.R. Qureshi (Pakistan)

Member: Mr. Tran Van Tri (Vietnam)

Secretary: Mr. J.A. Tubb (FAO)

Technical Committee I

Chairman: Dr. Nazir Ahmad (Pakistan)

Technical Secretary: Mr. W.A. Dill (FAO)

Panel A–Inland Fisheries

Chairman: Mr. K.A. Hussain (Pakistan)

Panel B–Sea Fisheries

Chairman: Mr. S. Sivalingam (Ceylon)

Hilsa Sub-Committee

Chairman: Dr. M.R. Qureshi (Pakistan)

Rastrelliger Sub-Committee

Chairman: Mr. V. Soesanto (Indonesia)

Chanos Sub-Committee

Chairman: Dr. H.R. Rabanal (Philippines)

Fish Culture in the Rice Fields Sub-Committee

Chairman: Mr. M.A. Indrasena (Ceylon)

Technical Committee II

Chairman: Mr. S.A. Jaleel (Pakistan)

Technical Secretary: Dr. G.N. Subba Rao (FAO)

Panel A–Craft and Gear

Chairman: Mr. M.A. Burney (Pakistan)

Panel B–Food Technology

Chairman: Mr. Lee Bong Nae (Korea)

Panel C–Socio-Economics and Statistics

Chairman: Mr. Abdul Halim (Malaya)

Technical Secretary: Mr. Y. Miyake (FAO)

Fish Marketing Sub-Committee

Chairman: Mr. N. Oka (Japan)

Convenor of the Symposium, 10th Session: Mr. Lee Bong Nae (Korea)

Rapporteur of Symposium, 10th Session: Mr. Jan-olof Traung (FAO)

FAO and IPFC Documents issued

IPFC Fisheries Products Manual, 1st Draft, together with addenda 1 and 2.

IPFC Occasional Paper 61/1– "The Rastrelliger Fishery Research Programme in Thailand" by S. Bandhukul.

FAO Fisheries Biology Synopsis No. 4, Synopsis on Biological Data on Milkfish, *Chanos chanos* Forskal, 1775 by H.W. Schuster.

Films on Fisheries and Related Subjects, prepared by FAO Fisheries Technology Branch.

PERSONALIA

Mr. Heraclio R. Montalban, Director of the Bureau of Fisheries, Department of Agriculture and Natural Resources, Republic of the Philippines, retired on 30 November 1960, after completing 39 years of government service. Mr. Montalban was appointed Director of Fisheries by the late President Ramon Magsaysay on 30 July 1956. Prior to this appointment, Mr. Montalban's splendid record in the government service revealed a pioneering spirit in Philippine fisheries science. He was the first Filipino to be conferred the degree of M.A. in Zoology (Ichthyology) by the Stanford University, U.S.A. in 1923. From then on he centered his interest in fish culture and ichthyology and his scientific works include studies on the systematics of Philippine fishes, culture of saltwater and freshwater fishes, exploration and survey work on Philippine fishery resources and industries. Mr. Montalban has participated and represented the Philippines in international conferences and seminars. He served as delegated to the First Pan-Pacific Food Conservation Conference in Honolulu, Hawaii in 1924; alternate delegate, Fourth IPFC Meeting in Quezon City, Philippines in 1952; delegate to the FAO Regional Conference for Asia and the Far East held in Bandung, Indonesia in October 1956; associate in the FAO Council Meeting and Associate and Adviser in the FAO Conference both held in Rome, Italy in 1957, member, Philippine delegation, to FAO Regional Conference held in Tokyo, Japan in 1958.

Mr. Jose R. Montilla, Assistant Director of Fisheries was appointed Acting

Director by President Carlos P. Garcia on 2 December 1960.

Mr. Justo R. Montemayor was appointed Supervising Economist (Section Chief, Economics and Statistics Section) of the Fisheries Research Division, Bureau of Fisheries, Quezon City, Philippines, effective 30 March 1960. Prior to his appointment, Mr. Montemayor has served the Bureau as Statistician and Fishery Economist consecutively. He was a participant in the FAO Training Centres in Fishery Cooperatives and Administration, Sydney, Australia and Fishery Statistics, Bombay, India.

UNESCO Regional Marine Sciences Consultant

Mr. Bent Muus, of the Danish Institute of Fisheries and Marine Research, was appointed as consultant to the UNESCO Science Co-operation Office for Southeast Asia for a period of four months. During this period he will visit the countries of East and Southeast Asia for the purpose of surveying the situation as regards marine sciences, and advise UNESCO and the Government of the region about measures to be taken to promote the development of research in this field. Mr. Muus arrived in Djakarta on October 29. His mission forms part of UNESCO Regional Technical Assistance Programme.

CURRENT READING

"Fish, the Great Potential Food Supply" by D.B. Finn, Director, FAO Fisheries Division, Price: 50 U.S. cents: Man's unending search to be from hunger is leading him more each day to the oceans and the seas, where, according to an FAO publication, 90 million square miles of waters could be about as productive as arable land. Cevering more than 70 percent of the earth's surface, the waters currently only yield less than one percent of the food consumed by human beings. Yet they have produced fish at a rate which has grown from a world catch of 20.50 million metric tons in 1938 to 35.33 million metric tons in 1959. The possibility of utilizing this vast fish supply to provide the necessary protein in many developing countries, where lack of protein leads to malnutrition, is examined in a new FAO booklet, —"Fish, The Great Potential Food Supply", written by Dr. D.B. Finn, Director of FAO's Fisheries Division. The importance of fish, an excellent source of animal protein, is obvious when it is realized that more than half the world's population lacks sufficient protein to keep in good health. There has been a great increase in agricultural production in recent years, but nearly half of it has taken place in North America, which supports only seven percent of the world's population.

Dr. Finn writes "It is not suggested that the resources of the sea so vast that, given the men, money, means and equipment, it would be possible to make a huge increase in food production from this source. The truth is that noboby knows the extent of the resources of the sea, and one of the great tasks confronting mankind is to explore and investigate these resources and determine their nature and extent. But enough is known for

fishery biologists to predict that production of fish, crustaceans and molluscs, can probably be doubled without damaging present known resources. The immediate aim is not to double fish production but to bring about a substantial increase in those areas of the world where the need for animal protein is most urgent."

Such an increase in production calls for international co-operation to conserve, develop, husband and manage the world fisheries. No nation can single-handedly operate a program to boost fish production, if only because so much of commercial fishing is competitive. Then there is the need to mechanize fishing fleets, introduce new and improved types of boats, gear and equipment, and to teach fishermen to operate such engines and gear and to use new fishing techniques. There is also the need for proper storage, processing, transport, marketing and distribution of the fish and fish products. Progress in fisheries, greater in the past 30 years than in the previous 3,000, is meaningful, said Dr. Finn, when it is realized that as in other fields of human activity-agriculture, industry, science, etc.– the gap between the developed and the underdeveloped countries has tended to widen. Northern Europe, for example, increased its fish catch from 1,760,000 tons in 1938 to 3,160,000 tons in 1957 – an 80 percent increase. Compared with this, the fish catch of Asia rose only from 9,360,000 to 12,880,000 tons. And in Asia, one country-Japan-accounted for nearly half of the catch.

" Fishing, as an industry, is still at the stage reached by agriculture thousands of years ago," Dr. Finn records. "We still hunt fish over thousands of spuare miles of oceans and seas where no nation has rights and where the stocks of fish are wild. The aim in fisheries must be towards husbandry of individual ownership so that stocks of fish can be herded and grazed as a farmer herds cattle. It is doubtful if we can establish fish husbandry for certain species, but there are distanct prospects of success with others, provided nations co-operate in seeking the orderly development of world fisheries."

International and regional meetings have been used, and will continue to be used, by FAO as means to focus attention on particular problems in the development of world fisheries. Training centers have provided an effective medium for spreading technical knowledge quickly to key points in a region, and FAO makes as much use of them as funds and staff permit. These centers have been held for fish processing technologists, fish marketing, fishery statistics, etc., in Latin America, Asia and the Far East and in Europe. In India, hundreds of fishermen have trained at eight training centers operated by the government and organized by FAO. These men have received in struction in navigation and the operation of mechanized boats, gear and equipment.

"The remarkable thing we have proved is that in a six month training course, we are able to teach illiterate fishermen to use effectively, compasses, dividers and charts," writes Dr. Finn. "and to operate small powered fishing boats equipped with gurdies and nylon gill nets. These men are so successful

that, after deducting a substantial part of their catch to pay for the boat, gear and equipment on an instalment system, they still earn two or three times as much as their fellow fishermen who use traditional log raft catamarans, dugout canoes and local types of nets."

Encouraging reports on fish stocks have been received from experts working in various countries, pointing clearly to great possibilities for increasing fish production, Dr. Finn reports. One expert working in Saudi Arabia was able to help organize fleet fishing operations in the Red Sea. Another expert obtained encouraging results in experimental fishing off the coast of Syria and Tunisia. Another expert aided the development of a Mediterranean shrimp fishery.

"All these facts support the view of many fishery experts that the stocks of fish in several parts of the world are underexploited. Among these areas may be mentioned the Arabian Sea and the Persian Gulf, where anchovy and similar species are caught, the southern waters of Australia, the west coast of South America and the English Channel, where there are substantial stocks of pilchards. New stocks of crustaceans and molluscs have been discovered recently, in areas such as those lying off the east coasts of America and of Australia and in the Gulf of Mexico. Crayfish are being fished in South Africa and Western Australia. This by no means exhausts recent discoveries and it seems most likely that, with the more intensive development of fisheries which is taking place in all parts of the world, new fishing grounds for crabs, lobsters, etc., will be discovered. The potentialities for fish production in inland waters are vast." It has been estimated that there are 37 million hectares of cultivable inland waters in the Indo-Pacific region alone. Such fish culture allows the fish to be reared where they are needed and harvested when they are required-eliminating many of the problems of transport, preservation and marketing, writes Dr. Finn.

Introduction of fresh water fish in wet rice paddies has shown that the fish feed on insect, animal and plant pests with a resulting beneficial result on the rice crop, Dr. Finn records. Many people believe the rice yield could be boosted as much as seven percent in this manner, plus the additional production of fish, he said. This type of fish farming should be introduced on a wide scale in India, Egypt, Burma and in other countries where rice is grown in wet paddies.

"The brief surveys we have made of the potential supply of fish from marine and fresh water leads invariably to the conclusion that the present world fish catch could be more than doubled," writes Dr. Finn. "There is much evidence to suggest that existing known stocks are sufficient for a catch of 50 to 60 million tons to be made and maintained yearly without taking into account the possible discovery of new fisheries. "Progress toward this total will be controlled not by the stocks of fish, but by other factors such as mechanization of fishing boats, gear and equipment, training of fishermen, development of fish processing and organization of transport, distribution and marketing in the underdeveloped areas of the world—and international cooperation."

Fish Meal Manufacturer's Meeting:

The International Association of Fish Meal Manufacturers met in Hamburg during the second week of June 1960, to discuss future cooperation in scientific research. Participants included delegates from the U.K., West Germany, Norway, South Africa, Spain, Iceland, Portuguese Angola, France, and Belgium. Holland, which is not yet a member, sent an observer. Also an observer from FAO and the Federal Research Institutefor Fishery in Hamburgh took part in the meeting. This meeting established a Scientific Sub-committee to work out chemical and physical examination methods with the view in mind of making it possible to eliminate fish meal of poor quality. Efforts shall be made to include uniform quality requirements for fish meal in the feed legislation of the member countries.

The FAO observer read a paper suggesting a plan of organization to carry out a study of the present and the prospective future trends on the international fish meal markets. The study shall also deal with the future importance of fish meal in animal feeding and in human consumption. The participants welcomed the plans of FAO and pointed out that in the long run the carrying out of these plans could be of great benefit. Three U.S. Companies have applied for membership of the Association.

Fourth Seaweed Meeting

The Fourth International Seaweed Symposium will be held in France at Biarritz (Basses-Pyrenees) during 18-25 September 1961. The object of this Symposium is to study marine algae from their biological, chemical, ecological, technical and economic points of view. The registration fees are 45 for members wishing to participate and 15 for members attending. All those interested in the study and uses of marine algae are invited to participate and to submit papers if they wish to do so. Algological excussions will be organized on the French Basque Coast during the Symposium. Those wishing to participate may apply to M. Barriety Directeur du Centre d'Etudes et de Recherches Scientifiques, Post Box 28, Biarritz (Basses Pyrenees), France.

FORTHCOMING MEETINGS AND TRAINING CENTERS

Date	Subject of the Conference	Convening Body and/or Organizers	Location
	1961		
	MEETINGS		
20-29 March	International Emergency Meeting on Fish Meal	FAO	Rome
12-17 June	Expert Meeting on Economic Effects of Fishery Regulations	Hamlisch (FAO)	Ottawa
19-27 Sept.	FAO International Meeting on Fish in Nutrition	–	Washington, D.C.
Undet.	FAO/ECAFE Meeting on Food Consumption Surveys	–	Bangkok
Undet.	Joint FAO/WHO Expert Committee on Nutrition	–	Geneva
September	Special Meeting on Fisheries Research Vessels	Jan-Olof Traung (FAO)	Tokyo
	TRAINING CENTERS		
6 March - 15 April	Training Center in Fish Processing Technology	R. Kreuzer (FAO)	Quezon City, Philippines
September	Fishermen's Training Center	–	South Pacific Commission Area

IMPORTANT IPFC PUBLICATIONS

PROCEEDINGS (Records of Council Sessions.)

*First Meeting, Singapore, 24 - 31 March 1949

Section I:	Report of Proceedings
Section II:	Working Papers
Section III:	Contributed Papers
Section IV:	Symposium Papers

Second Meeting, Cronulla, N.S.W., Australia, 17 - 22 April 1950

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

Third Meeting, Madras, India, 1-16 February 1951

Section I:	Report of Proceedings
*Section II:	Technical Papers
*Section III:	Symposium Papers

Fourth Meeting, Quezon, Philippines, 23 October - 7 November 1952

Section I:	Report of Proceedings
*Section II:	Technical Papers and Symposium Papers

Fifth Meeting, Bangkok, Thailand, 22 January - 5 February 1954

Section I:	Report of Proceedings
*Section II:	Technical Papers
Section III:	Symposium Papers

Sixth Session, Tokyo, Japan, 30 September - 14 October 1955

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

Seventh Session, Bandung, Indonesia, 13 - 27 May 1957

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

Eighth Session, Colombo, Ceylon, 6 - 22 December 1958

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

(* Items so marked are out of print.)

Ninth Session, Karachi, Pakistan, 6 - 23 January 1961

Section I:	Report of Proceedings (in Press)
Section II:	Technical Papers (under preparation)
Section III:	Symposium Papers (under preparation)

CURRENT AFFAIRS BULLETIN

No. 1-30 July 1951 - April 1961 (*1-21, 23)

SPECIAL PUBLICATIONS (Irregular)

*No. 1: Schuster, W.H. (1952). Fish Culture in Brackish-water Ponds of Java. 1 - 143 pp.

*No. 2: Anonymous, (1952). Fish Culture in Indonesia. 1 - 126 pp.

No. 3: Zaneveld, J.S. (1955). Economic Marine Algae of Tropical South and East Asia and their Utilization. 1 - 55 pp.

No. 4: Anonymous (1958). Annotated Bibliography on Fishing Gear and Methods.

MISCELLANEOUS

Directory of Fisheries Institutions—Asia and the Far East.

1961 OCCASIONAL PAPERS

No. 61/1 The Rastrelliger Fishery Research Programme in Thailand, by S. Bandhukul.

(* Items so marked are out of print.)

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